

JUNE 1943
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AVIATION

The Oldest American Aeronautical Magazine

IN THIS ISSUE

AIR FREIGHT, UNLIMITED

— how airplanes were used exclusively to transport materials and equipment to build the great Shipshaw hydro-electric project in Canada.

★

WARPLANES FLY HOME FOR REPAIR

— they come under own power, and Air Service Command gets them back to fighting fronts in record time.

★

FABRICATING STEEL DROP TANKS

— a step-by-step description of how Lockheed builds drop tanks for P-38 Lightnings.

★

CENTRIFUGAL CASTING OF CYLINDER BARRELS

— Ford's revolutionary process described in detail.

★

CONSERVATION STARVES THE SCRAP BARREL

— planned conservation pays vast dividends in keeping usable material out of the scrap bin.

★

DURAMOLD SPEEDS STABILIZER PRODUCTION

— how the molding process gives a stronger, lighter structure in less time at less cost.

★

EFFECT OF SCRATCHES ON ALCLAD

— conclusive tests show effect on fatigue strength and indicate needless rejection of sheet by present standards.

★

HIGH STANDARDS BY QUALITY CONTROL

— a description of Ryan's successful method of controlling quality of goods produced.

★



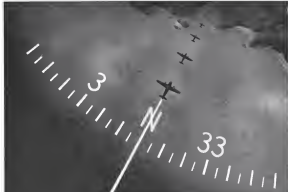
Marauders ON THE RAMPAGE

Consternation reigns in Axis ranks when Army B-26 bombers loom up. These versatile Martin Marauders can carry bombs, torpedoes or depth charges, plus the firepower to strafe or bottle as fighters, plane to plane. Their mighty Double Wasp engines pack 2000 horsepower each, to help make them the scourge of the skies.

PRATT & WHITNEY AIRCRAFT

EAST HARTFORD, CONNECTICUT

ONE OF THE FOUR DIVISIONS OF UNITED AIRCRAFT CORPORATION



BUILDING BOMBS is tough work in any sense, building two big ones in Canadian winters tougher still. But when every pound of materials, men, and machines are taken to the otherwise inaccessible site by air, it makes one of the outstanding chapters in air transport history. Armstrong's first factory flew to the scene and brought back the first detailed store on the great Staphors by the electric project "Air Freight, Unfettered" begins on page 118.

ARMSTRONG'S BOMBING PLANS not only fly to any and all battlefronts, they move home under their own power for major overhauls—in short, what some soldiers thought could never happen is now regular practice. As part of one of his regular maintenance flights, performing material, Kenneth Edgar John Foster "went through the mail" at the Oklahoma City Air Depot and came out with the first one of many of the great work being done by the "bomber" and ten others, again by the Air Service Command, its article, "Fighters and Bombers Fly Home for Repairs," makes it much easier to understand why United States airplanes are piling up such remarkable records. See page 123.

POWERFUL ENGINES are being supplied, or they can be made very rough—depending on who's doing the supplying. But so matter how simple or complicated, they must deliver. If we are truly satisfied about the future, as a powerful one is the world's national on page 131, national leaders will call upon armament men to help in that all important job. Now it's the General's and Research Commission that's getting involved in the aviation business. This time it's a "crisis" of profits, which it says has not up as a measure of recognition among those great "bombers" of over 100 percent on increased output. The FBI clearly has vast implications for the industry, analyzed on page 132 after the question, "... And Just Where Are These Profits?"

COMMEMORATING FIVE YEARS' experience in centrifugal casting of engine cylinders barrels, Ford now applies the method to aircraft engines to replace drop forgings. Details of the method, which saves 30 lb. of steel per barrel and which uses equipment now standard in shops, are given in the full-length article by Herbert Chase on page 134.

THE CONTINUOUS FIVE TB of the engine on flight—using the late great Robert Allen—has just written—explains the procedure employed at Boeing Aircraft



Bert Mulford, quality manager of Pratt & Whitney, who has made a very tangible mark in an airplane factory—quality control. The highly successful system he has set up, is explained in an analysis of the East Coast Aircraft Co. Production Control, is thoroughly documented in his article on page 136.

ON AN INCH WIDE and flying. The author's is on page 147. Like Ford II it was put in a limited form from Allen's notes and rough drafts by his associates, who are carrying on the work to which he contributed so much.

HEAVYMAN CONSTRUCTION grows in importance every day—because it's necessary to meet wartime production schedules and because progress profits immensely.



Just released is the story of mass dropping of Lockheed P-38 Lightnings from Henry to England and, for some of the planes, another long jump to Africa. Great fighters the range necessary depended wholly on disposable gas tanks. How Lockheed built those tanks at the rate of one every 45 min. is detailed on page 139 by E. A. Van Dine. Lockheed's vice-president in charge of manufacturing. With one of the P-38's are two RAF pilots who made the trip—Sgt. S. Kelly, Capt. S. Hough, James E. Rogers and John K. Greenberg.

operations can't start without it. Means for testing used in the drive are given by C. D. Martin. Turn to page 138.

CONVENTIONS AND CONFERENCES of the latest in design and production processes, AIRFRAME progress—on page 150 up to the minute details in the item, would present, explaining how the making methods make it possible to distribute weight according to stress patterns and also to give exceptionally smooth shaping of curved air surfaces.

AN AIRFRAME LONG OVERSTRESSING to Allied aircraft designers is contained in our study (page 154) on the effect of an airframe on fatigue strength. For those results of extensive tests show that stresses are more severe than those found in service do not necessarily reflect the effect of fatigue characteristics.

EVERY PLANE CANNOT HAVE CANNON mounted a lot of weight that would depend on its own—something which can be balanced on either the designer or producer. Instead of adding to plane, there now comes the idea of "Bypassing" by Substitution—making every ounce of weight functionally essential. It's a thought-provoking design philosophy developed on page 155.

ARMSTRONG'S BOMBING PLANS are very timely of weight, resources don't permit its status in the demand system. The development of very light, lightweight, high output production which have been battle-tested is portrayed on page 155.

Veteran Guide OF "THE INVISIBLE CREW"

FOR a quarter of a century and more, the "PIONEER" Bendix-Bushings Magna has been employed in navigating the air. After types of direction-finding devices have come into use—including the "PIONEER" Remote Radio-acting Compass—yet, however, using magnetic compasses are still very rarely installed on modern aircraft.

This veteran guide is based on practically every type of plane—other than the whole range of flying from low to high altitude and on various conditions of flying—diversity. A director of "The Invisible Crew" is the late, previous lead "PIONEER" Bendix-Bushings Magna Compass was not one of the many light, navigational and engine instruments being manufactured at Pioneer plants. In stead of equipment, these instruments in the hands of flying personnel and are transparent of the United States.



The "PIONEER" Magnetic Compass is a word member of "The Invisible Crew"—precision equipment which 20 Bendix plants have used to assist in equipping the air fighting crews on world battle fronts.

PIONEER INSTRUMENT DIVISION

THE NIGHT OF JANUARY 21st

It happened barely two years ago — on January 21, 1941 — and already it is changing the shape of the world. On that night, men held in their hands a bar of the world's lightest metal — the first ingot of pure magnesium — was taken from the sea.

The men were chemists and engineers of Dow Chemical Company, and the metal ingot which they held that night was the creature of many years of experiment in the field of ocean mining. As a result of those years of search and research, most of our production of over 100 million pounds of magnesium this year will come from the limitless sea, and plants are building for the production of many times that amount. Also as a result of those years, a whole new age of light metal parts products — and problems — has begun.

Today, 99 per cent of all magnesium production is going into aircraft. But after this war, with a wealth of experience, new techniques and a swelling capacity, magnesium will be ready to bid for other markets, streamliners, buses, trucks, trailers, engine forgings, household appliances, building materials, and the whole broadening field where weight and load factors are of increasing importance. And with the new production will come the problems.

As specialists in internal grinding — with engineers and machines on nearly every aircraft production line in America — we at Bryant have had a great deal to do with parts made from lightweight metals. We believe that this knowledge can be of greater value to you than ever before in meeting today's efficiency requirements and in planning ahead for tomorrow's. Bryant's Consulting Service is available to you at all times. Call upon us now!

Bryant Chucking Grinder Company

SPRINGFIELD, VERMONT, U. S. A.



SEND FOR THE MAN FROM BRYANT!

AVIATION, June, 1942



IT'S a vital role the Piper BE-1 Ambulance Plane is playing — a role that is saving many American lives! Landing in small fields where most planes could not operate, the "Air Ambulance" picks up a casualty and carries him, comfortably cradled under the plane's padded turtle deck, to a local hospital. It transports him with speed that often means the difference between life and death.

Built especially for the Navy, it adds another gear to the story of services rendered our Armed Forces by Piper Cub planes. The important parts played by this "Air Ambulance" and the famous Piper L-4 "Grasshopper" daily bring victory nearer!



And, when peace comes, the lessons learned and the developments made during this war will continue to bring you a superb peacetime Piper Cub plane. In it, you'll fly to your favorite vacation spots and wherever your business trips. There small airports and highway landing strips will dot the country. And light airplanes will dominate the air just as popular-priced automobiles dominate the road!

FREE BROCHURE BY MAIL TO YOU. Send today for your copy of the easy-to-understand booklet "Tom, Tom, Cue Fly!" If you also want the full-color Piper catalog, enclose 10c in stamps or coin for postage handling. Piper Aircraft Corporation, Dept. 302, Lock Haven, Penna.

MODEL, TRIPLE DECK. — The Construction of a Light Airplane" now available. For grant of patent, distribution, write the publisher: Superiors, Aviation Visuals, Inc., Foreman Services, Pennsylvania State College, State College, Pennsylvania.

PIPER *Cub*
POINTS THE WAY TO WINGS FOR ALL AMERICANS

AVIATION, June, 1942

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with
JACOBS AIRCRAFT
Engines

Each day the future Bomber Pilots of the United Nations are flying Jacobs-powered twin-engine Trainers more than 1,000,000 miles, from United States and Canadian training fields, acquiring the skill and precision that will devastate the factories and ship-yards, the railroads and power lines of the Axis—and that soon will blast the way for our Armies to Berlin and Tokyo.

Day-in and day-out these sturdy engines are ready to go—from dawn to dusk and into the night—as their essential mission of qualifying the Bomber Pilots for their job of freeing the World from the ruthless selfishness of Hitler and Tojo.

When this job has been accomplished, these sturdy engines will carry millions of free people safely and economically on missions of commerce, of mercy and of pleasure.

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PHILADELPHIA - PENNSYLVANIA U.S.A.



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People are prone to think of battles in terms of body men power and guns weapons. These are the glamorous things. Yet back of all these are the unglamorous "practical" needs of armies, navies and air forces.

As Engineers at Purchasing Agent, you know full well the great importance of wire and cable selection to assure adequate power,

efficient lighting and reliable operation of complicated instruments on modern war planes. Auto-Lite engineering and research have played a major role

in producing low impedance wire and cable daily winning service stripes on battlefields all over the world.

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BE FIT IN GREAT QUANTITIES. AUTO-LITE IS FURNISHING A LONG LIST OF STARS FOR AMERICA'S JAPANESE IN LAND, AIR AND IN THE AIR.

AVIATION, June, 1945



What it takes to stir up 25 HURRICANES IN A TUNNEL



Westinghouse has designed and built over 115 tunnels as much big as wind tunnel drives as the rest of the electrical industry combined. Today, the largest wind tunnel in the world (at Wright Field), the largest constructed for private industry, and the largest built for electrical installations, all are powered by Westinghouse drives.

When nature starts up a 75-mph wind it's called a hurricane. But today, man can create a wind equal to the force of 25 hurricanes—with velocities approaching the speed of sound.

From these huge "wind tunnels" is coming a great new kind of aerodynamic facts—to increase the power and speed of America's fighting planes.

In the world's largest high-powered wind tunnel at Wright Field, two 30-foot propellers, each weighing 42 tons, are required to push air around at 300 mph. Driving these huge fans is a 30,000-hp induction motor, the world's largest. The driving motor, and its complete electrical systems, was designed, built and installed by Westinghouse.

The tremendous horsepower required is only one of the many problems faced in building such drives. They must be capable of wide speed adjustment, and must be able to hold any desired speed nearly constant while complete loadings are being taken, regardless of fluctuations in load or power supply. Yet all these and many other problems have been satisfactorily solved, to help Uncle Sam speed the day of Victory.

The ability to design and build such drives is typical of the specialized service Westinghouse offers the Aviation industry. For help in any problem involving the application of electrical power, please your nearest Westinghouse office. Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

24312



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PLANTS IN 25 CITIES... SERVICE EVERYWHERE

plane talk

ELECTRICAL
DEVELOPMENTS,
IDEAS,
APPLICATIONS FOR THE
AVIATION
INDUSTRY

A-C SYSTEM STUDIES: The increase in size and power demands of aircraft, and the distance over which power must be distributed within the plane, have placed a heavy weight penalty on low-voltage d-c systems. Since the use of higher direct-current voltages is not considered practical for certain of these planes, much study is being given to the application of a-c power systems.

By means of the A-C Calculating Board, widely used for making system studies for utilities, Westinghouse engineers have made much progress in the analysis of a-c requirements for planes. Actual equipment has been developed to the point where a-c generators, voltage regulators and transformers will soon be available.

* * * * *

PHOTOGRAPHING SPARK PLASMA PERFORMANCE: The study of high-speed electrical impulses, such as occur in the firing mechanism of an aircraft engine, has been an important contribution to increased engine performance. For this purpose, the Westinghouse Cathode Ray Oscillograph is ideally suited. Also used in the study of lightning surges and high-voltage and current phenomena, this device can record phenomena at speeds of 1/100 of one-millionth of a second.

* * * * *

SOLDER SEALING of entrance bushings greatly simplifies the problem of protecting electrical equipment against harmful effects of condensation, high altitude and humidity.

Capacitors, transformers and other apparatus can be hermetically-sealed, quickly and inexpensively, by means of this exclusive Westinghouse process.

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NEW AVIATION EQUIPMENT BOOK containing valuable information on Westinghouse equipment for the Aviation industry, is now available. Write for copy of Booklet E-3295.



Westinghouse

Wings with sinews of **STEEL TUBES**

FOR AMERICA'S FLEDGLING FLYERS



CONSOLIDATED VULTEE BASIC TRAINER — XT-29 parts built strong and light with the same reason: Alloyed Tubing that is used in fighters and bombers.

SHELBY SEAMLESS AIRCRAFT TUBING — standard, oval, diamond, square and rectangular.



SHELBY SEAMLESS
Aircraft Tubing



UNITED STATES STEEL

FLEDGLING flyers need a plane that will take a beating—one that will stand the bumps, jerks and crazy maneuvers caused by inexperienced hands on the controls. Wings and engine parts, too, are securely mounted to absorb such shocks continuously. That's why so many basic trainers are built with Shelby Aircraft Tubing to obtain the lightest, strongest construction possible.

Consolidated Vultee's basic trainer is one of a number of well-known trainer planes using Shelby Aircraft Tubing for fuselage sections, engine mounts, and other parts requiring great strength. This construction withstands vibrations, fatigue, and sudden stresses and strains.

Alloy steel tubing has the highest strength-to-weight ratio of any structural section under the severe stresses to which airplane structures are subjected. Today, too, in great bombers and other combat planes, such vital parts as wing spars, fuselage struts, longerons, engine mounts, and landing gears are made from seamless alloy steel tubing.

No matter what type of plane you build, there is a shape and size of Shelby Aircraft Tubing for every modern aircraft. It is made to exact government specifications and meets just our own special tests before it is shipped. Write for our book giving complete details.

NATIONAL TUBE COMPANY

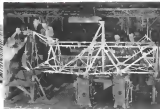
PITTSBURGH, PA.

Columbia Steel Division, San Francisco, Pacific Coast Division

United States Steel Pipe Company, New York



SEAMLESS STEEL TUBES welded together to form a homogeneous fuselage structure bonded to reinforced stress from any angle.



ENGINE MOUNT of Shelby Seamless Tubing assures great strength with high resistance to vibration and fatigue.





"Black Light" testing makes visible the hard as polished steel surface of all Mallory Bearings. Under the rays of an ultraviolet light and made visible by fluorescence, a dye can not make visible from the "Black Light" allowing only ultraviolet radiation to pass.

MALLORY Bearings

Meet Critical Loads Superbly

WHERE ordinary bearing surfaces are inadequate to meet the stresses and strains a fighter plane's engine must undergo, Mallory Bearings function superbly. They can take the terrific pounding and fatigue stresses imposed by suddenly applied loads from a high-powered piston plane in action.

Mallory Bearings are made by Mallory's Mallory Process of hardening silver to hard metal bearings. They provide a tough, homogeneous, heat dissipating silver surface of high fatigue resistance; ample strength and hardness; and high resistance to seizure.

What is more, Mallory Bearings are precision made. Through use of newly designed precision tools and test instruments, skilled Mallory craftsmen have set remarkable records for exactness and uniformity in producing bearings, bushings, pinion races, gear races and other aircraft engine parts. With tolerances measured in split-thousandths, they are turning out ever-increasing quantities of precision parts with an economy and uniformity considered impossible only a few short months ago.

Continuous experimental designing and testing indicate even greater results for the future. The experience and technique gained in War production will be available for commercial motor development when Peace has arrived. Commit us on the possibilities of the Mallory Process for you.

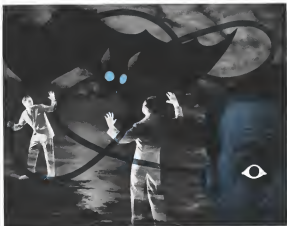
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The creature no one knows...

IN THE HALF-WORLD between day and night an eerie, sinister creature emerges from hiding. Its identity is unknown. It is the bat, the only mammal which flies. Of all the creatures known to man, bats are the most mysterious. They do not mate when other animals do. And no one knows where they go at migration time.

Yet bats are the most highly specialized mammals on earth. If we had the intricate ears of bats, we could hear an ant walking. If we had their incredible coordination, we could fly at the speed of a locomotive toward a telephone wire... at dusk... yet miss it! Or dash blindfold around hundreds of objects and not touch one!

But if you think that's specialization, listen to this

The production giant of the machine tool industry—Cone's multiple spindle automatic lathes—can do as many as 8 different jobs simultaneously... in a matter of seconds... or perform as many as 17 different operations on a part—more than one every two seconds—with the deftness of a master craftsman!

The prime task of Cone Automatic Machines today is to help speed war production. In the future, by making possible increased production, they will increase purchasing power... and so increase employment. As a result, Cone Automatics will make major contributions to social and economic good of the future.



ONE Automatic Machine Company, Inc., Windsor, Vermont





TINY... BUT PACKED WITH POWER

Small size and light weight are only part of the story behind Automatic Electric's new Class "S" Relays. Designed to meet the punishing conditions of operation on the fastest modern aircraft, they offer a combination of features never before found on any relay, large or small. Here, for example, are three of the many basic improvements in these tiny but powerful relays.

FIRST: resistance to vibration has been built-in—not "added on." The most punishing aerodynamic stress find to cover false contact operation even under vibration conditions far beyond the limit of human endurance. Class "S" Relays withstand, with a substantial margin of safety, the most rigorous operating tests required for aircraft relays by the Signal Corps and the Air Corps.

SECOND: maximum contact dependability is provided through a unique type of spring design, which provides high contact pressure within small space limits. Independent, self-aligning twin contacts provide additional safeguards.

THIRD: A new type of pin pivoted armature with full length bearing provides exceptionally long life under severe service conditions.

For the complete story on Class "S" Relays, write for the engineering data sheet, giving full specifications:

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1512 West Van Buren St. Chicago, Illinois

Relays
AND OTHER CONTROL DEVICES
by **AUTOMATIC ELECTRIC**

PARTS AND ASSEMBLIES FOR EVERY ELECTRICAL CONTROL NEED



Class "S" Relay—Single Arm

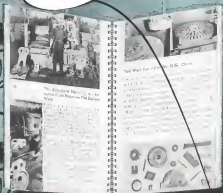


Class "S" Relay—Double Arm

Class "S" Relays are available with a wide variety of coil and contact combinations and operate on various voltages. The classic arm relay has a capacity of one contact spring—the double arm, double strength. Relays may be provided in any combination and arrangement of "board", "in-line" or "board make" assemblies.

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Whether or not you own a Blanchard Surface Grinder, the Blanchard Work Book will show you how to handle your surface grinding job more safely, accurately, and economically. There are 112 pages, spiral bound for easy reference, packed full of practical data and information on grinding steel or bronze bars. The coupon is in your convenience — Write for your Work Book TODAY!

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To further the war effort, we are today producing an ever-increasing supply of fine control bearings—**QUALITY BEARINGS**—for the air forces of the United States ARMY, NAVY and MARINES.



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ENGINE TEST EQUIPMENT



DESIGN - ENGINEERING - CONSTRUCTION - SERVICE

JACOBSON & COMPANY, INC.

EXECUTIVE OFFICES: 335 EAST 45th STREET, NEW YORK, N. Y.

IN CANADA: JACOBSON & COMPANY, LTD., MONTREAL, QUE.



THIS EXPERIENCE CAN SERVE YOUR NEEDS

WAR-ACCELERATED obsolescence in aircraft engine designs, plus demands for greater versatility in engine test units, have posed new problems for designer and user of engine test equipment. It is our daily job to keep a step ahead of current engine design to be on time for tomorrow's changes, planning sufficient flexibility to accommodate the maximum number of current models-of foreign as well as domestic engine designs, in sizes ranging from the smallest engine to the largest.

With experience in meeting and solving new problems in this field, the Jacobson engineers have accumulated a knowledge of engine testing that is proving invaluable under the pressure of wartime expansion, and is enabling the organization to meet today's needs and anticipate tomorrow's.

THE COMPLETE SERVICE. The success of Jacobson installations in all parts of the world stems from the fact that the company offers a complete service: the design, engineering, manufacture, and installation of engine test equipment. Add to this the fact that more than four hundred Jacobson-designed-and-built test stands are in operation in the country alone (and nearly every unit was designed for a certain set of conditions) and one can readily see why Jacobson & Company are in an unusual position to undertake virtually ANY job connected with the installation of engine test equipment to meet ANY special set of conditions.

DESIGNING engine test equipment at Jacobson includes everything from the development of highly specialized test instruments to the layout of details of the test building.

"Advanced planning" is necessary to realize long-time service life from the investment and to assure that changes in engine design will not cause undue obsolescence in testing equipment. By working in close cooperation with the engine manufacturers and with the technicians of the Army and Navy Air Forces, our engineers are in a position to know the trends in design and can plan test equipment to meet them while they are still in the blueprint stage.

Similarly, the long experience gained through the installation of test units under the extremes of service and operating conditions enables Jacobson engineers to plan new designs in the drafting room which will meet unusual conditions encountered in the field. For example, in a test unit somewhere in Central America, the unusually heavy rainfall required specially-designed intake stacks to avoid flooding the

test chamber, and the constant high temperatures at sea level necessitated the installation of refrigeration equipment to cool the air at the carburetor section of the engine. Incidents like this, seemingly small in themselves, are extremely important in the successful design and operation of test equipment.

ENGINEERING. A complete engine test installation requires the specialized knowledge of many fields. Among others we perform the service of design, research, calculation, instrumentation, as well as offer a consultation service to the architect.

CONSTRUCTION of a test installation for single or multiple engine testing involves many trades: the supplying and supervision of skilled and unskilled labor; securing and coordinating the flow of materials and equipment; special consideration to the structural problem and the proper correlation of all construction in the field. Jacobson service is set up to control the entire fabrication of the test units, including proper installation of all instruments, controls and test equipment, under one experienced responsibility.

INSTALLATION of the job includes responsibility for the successful functioning of the completed unit and the instruction of customer's employees in its proper use and maintenance.

Should modification or expansion of the equipment be required to meet new designs or other changing conditions, Jacobson can supply any or all additional equipment or service that may be required. Should unusual problems be encountered in any phase of engine testing, the services of a field technician can be obtained quickly to insure proper functioning of the equipment at all times.

Because of the multiplicity of problems in engine test equipment design and the seemingly insurmountable details involved in even the simplest type of test unit, the advantages of the service such as Jacobson & Company offers, covering every phase of the job of design, engineering, manufacture and installation of engine test equipment, become apparent.

Many leading organizations are utilizing this unique service. Among them are those listed on the following page.



Jacobson test stands are designed for use with both liquid and air flow engines. Equipment and accessories can be provided for testing either air or both liquid and air-cooled types.



Jacobson engineers' latest project: a complete assembly of all test equipment in the plant before shipment abroad.



Supplying and installing the engine test material for water collection is part of Jacobson's work.

JACOBSON & COMPANY, INC.

Jacobson installations are located in all parts of the United States, as well as in Canada, Alaska, the West Indies and Central America. We are equipped to meet your needs in any part of the world.

One of the complete Jacobson engine test installations, designed and built for Cessna Wright Limited.



The proper relation of controls and instruments gives the latter instant data on the functioning of the engine.



TRUE STORIES ABOUT
Lockheed



Aerial photography has become such an important part of modern warfare that some of our best pilots and best pilots have been diverted from actual combat to take the pictures necessary to victory. It's one sure way to locate the enemy, measure his strength, and also a strategy that will bear fruit.

Read the exciting story of Captain Pollard and the Lockhead Eighteen that became the "eye of the Civil Sea Battle" and you will understand why the sea forces of our Army and Navy can no longer use slow, underpowered planes as antiquated jobs that have a door hanging on our freedom.



1. Earl Phillips, U. S. Army Captain, was alleged to have told the Japs about to attack the U. S. Fleet in the Coral Sea his duty to get accurate information on the size and strength of the enemy forces as well as their location. Four powerful searchlights were installed in the case of his lighthouse. All eyes were directed toward his tower.



3. The Sacco of the Carolan Sea Battle is shown on this map. The lagoon area with a dark circle was covered completely by Captain Fodda. Developed parts of the immense region, though taken down in a storm of 17,000 feet, were almost as common as with a single line.

3. **Over the Coral Sea.** *Cygnus Poliflex* took pictures – pictures of land, water and ships that helped us plan victory. All four cameras were synchronized...one showing forward...one to the back...and one on each side. With one 'click' of the four shutters they accurately and simultaneously photographed an area of 2,500 sq. miles.



5. Go to Salween and see the pygmy tribe—The pygmies are doing their reconnaissance job. Have these men Zoroastrian? They are swayed at the stock, Chuking, doing, being in clouds, the lightning about them again and on, one more fire on the mountain where the sun was before.

8. While he was reporting to Col. "Burr" Wagner, the flying hero of the Philippines, Japanese planes attacked the airfield. But Polifka, confident of his plane even as his engine took off in the thick of the raid and fire on the safety of his home base belted down in the hangar twenty miles away.



4. Poliffo's Lockheed sighting proved to be superior over Japanese Zeros during the mission. Over Rabaul, one of three fighters took up the chase, jamming the throttle home. Poliffo cut speed, cut climbed them all, and did a few low-angle forward-swept passes.



This is one of a series of stories about Lockheed, a woman, and her accomplishments. Watch the pages of this magazine for another thrilling story on a woman.

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HYDRAULIC CONE CHECK VALVES . .

Removable stainless steel cone seat

Hardened steel cone poppet

Removable stainless steel cone seat

Hardened steel cone poppet



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The William R. Whorster Company, Ltd. is engaged solely in the design and manufacture of aircraft check valves.

All Whittaker valves whether for hydraulic, oxygen, vacuum, or fuel systems have unique qualities and are of the latest modern design. Shown above, the hydraulic cross check valve has:

1. A valve seat mounted in the end of the valve where it is readily accessible for servicing.
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3. A hand lapped hardened steel cone popper with passage holes that are parallel to the direction of flow.
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Getting Work Out of the OTHER HALF

This is half a machine. It cost full price, takes up full floor space, uses full operator's time—but it's just half a machine. That's because it is handicapped by a slow setup and removal cycle. It delivers only a part of its potential output.

One of the most important duties of **HECKER** tools, jigs and fixtures is to convert standard time into production.

The **HECKER** tool engineer takes account of the worker, the machine and the requirements of the job. Then he designs a tool to bring those three vital factors into the best possible adjustment.

HECKER tools have other purposes, too. It depends on the results wanted: Tool for inexperienced workers; tools to improve quality; tools to speed operating cycles; in short, custom-designed tools, built to the specific problem.

These engineers can see their own designs in daily operation on precision aircraft parts in the **HECKER** plant. That's an extra advantage in firsthand production experience which can help you get more work out of the "other half" of your machines. By way of demonstration, turn a real tooling problem over to **HECKER**—judge for yourself. Write (wire or phone if urgent) to A. W. Hecker, 1978 East 66th Street, Cleveland, Ohio; or, 517 New Center Building, Detroit, Michigan.

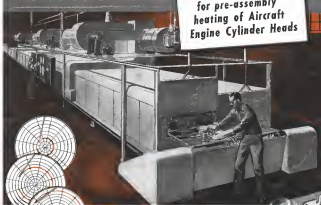


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DESIGNING AND BUILDING OF TOOLS, JIGS AND FIXTURES FABRICATORS OF AIRCRAFT PARTS

ILLUSTRATION: JOHN STANT

Another **MAHON Shrink OVEN** Installation . . .



Individual Control of Temperature in Each of 3 Heating Zones Prevents Distortion Losses . . .

Here is a new shrink oven design—that speeds up the pre-assembly heating of aircraft engine cylinder heads—reduces distortion losses to a minimum. It was developed by Mahon research engineers, in collaboration with the engineering staffs of leading airplane engine manufacturers. Unlike conventional shrink oven construction, this oven is divided into three separate compartments or zones, with the temperature in each zone individually controlled. As the heads pass from zone to zone they are brought to the required temperature by a graduated heating process. Distortion—caused by too rapid heating—does not occur. Resulting scrapage is avoided.

Two rows of cylinder heads traverse the oven progres-

sively through the three heat zones on independently adjustable shaft conveyors. Heads are placed on the first conveyor lanes in staggered formation—striding from the oven one at a time—for quick transfer to the assembly table in a continuous production flow.

Airplane engine manufacturers are making installations of these new ovens so rapidly as they can be produced. Several now in operation are effecting highly substantial savings. If you would like to know more about this improved shrink oven design—or the many short cuts and economies that other Mahon equipment makes possible—write or phone for an interview with your representative and without obligation.

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1909

U. S. ARMY GETS ITS FIRST PLANE



Delivery of first airplane to Mitchell Field on August 3, 1909, marked the birth of the U. S. Army Air Corps. Made by the Wright brothers, plane had top 80 1/2 ft. propeller driven by a 25 H.P. motor by means of chain and gears and could reach an air speed of 41 M.P.H. In this photo a balloon ascension basket is being "towed" (the other) from the plane.

....AND THAT SAME YEAR THE UNBRAKO SET SCREW WAS INAUGURATED

Reg. U. S. Pat. Off.

The history of military aviation in the United States . . . and the history of "Unbrako" Hollow Set Screws . . . both date back to the same year—1909. Today—34 years later—vastly improved planes by the thousands are being delivered to our armed forces . . . and "Unbrako" Hollow Set Screws by the millions are doing their bit to speed the production of these planes and other vital war equipment.

For big production machines . . . for delicate instruments . . . and for the equipment itself, "Unbrako" Hollow Set Screws—both Plain and Self-Locking types—use the choice of manufacturers who appreciate their amazing strength* and high degree of accuracy—made possible by the use of carefully selected steel . . . our own special heat treating process . . . and our precision methods of manufacture—plus 34 years of "know-how." To these advantages, add better-than-average deliveries . . . and you have plenty of good reasons why you should use "Unbrako" screws on your own machines. Write for the "Unbrako" Catalog

*No scientific study. "Unbrako" screws have registered an ultimate tensile strength as high as 120,000 lbs. per sq. inch.



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STANDARD THE
ALBERTSON & CO., INC.



WORLD OVER
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29

Announcing— FARROWTEST

—THIS NEWEST METHOD OF TESTING AIRCRAFT TUBING
PROVES THE SOUNDNESS OF REPUBLIC ELECTRUNITE

• Today's most positive method of testing steel aircraft tubing, FARROWTEST, is the culmination of 13 years of intensive engineering research.

Minute imperfections which may be invisible to the eye and imperceptible under ordinary methods of testing are easily detected. This test is made without the

application of physical strain, heat, or other test media which might even slightly impair the original properties of the tubing. FARROWTEST is an efficient means of making a *non-destructive* test by the application of electronics. It is applied to *EVERY LENGTH* of Republic ELECTRUNITE Aircraft tubing in order to prove its soundness before shipment.

ELECTRUNITE Tubing offers other advantages to aviation engineers and fabricators, too. Its wall thickness, diameter, strength, concentricity, weight, ductility, hardness, weldability, and smooth surface are *consistently uniform*—because it is cold-formed from flat-rolled steel and electric resistance welded.



Republic



Republic ELECTRUNITE Aircraft Tubing meets specification standards of the U. S. Army Air Corps; Bureau of Aeronautics, U. S. Navy; and the Civil Aeronautics Administration. It is made of S.A.E. X-4150 steel in sizes from 3/8" O.D. to 1 1/2" O.D.—.028" to .065" wall; of S.A.E. 1025 steel in

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Mfg. U. S. Pat. 2,610,000

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LORD MOUNTINGS Maintain Accuracy and Prolong Functional Life of AIRCRAFT INSTRUMENTS

LORD Shear Type Bonded Rubber Mountings isolate vibration, absorb shock and minimize all noise transmitted through solid conduction, providing protection for many types of aircraft equipment, ranging from heavy, massive assemblies to delicate instruments of sensitive action.

Rubber Mountings are made in Tube form and Flare form in various shapes and many sizes, with load ratings, ranging from a few ounces to 1500 pounds. They are sturdy, compact, lightweight units, and ease of installation is an important feature.

Perhaps in no other field where instruments, meters, or other measuring devices are employed, is it so vitally important to have instrument accuracy, dependable, and easy to read, as in aircraft. Complete instrument panels at individual meters can be protected from the shock and vibration of surrounding areas by being properly suspended on **LORD Shear Type Mountings**. Accuracy is thus insured, mechanical balanced, and functional life prolonged.

The late drawing of shear instrument panel shows typical method of suspension, using **LORD Flare Mountings** in series. Double or Series Mountings are formed by covering the entire diameter of two single units, as shown in elevations. This arrangement doubles the load carrying capacity and greatly increases the lateral surface, allowing greater freedom of movement movements. The increased deflection in all directions, decreases the external frequency of the measured

system and provides practically complete isolation against the harmful effects of vibratory forces. The degree of lateral deflection may be varied by inserting spacers between mounting units, increasing the distance between mountings increases the lateral resistance for any given force.

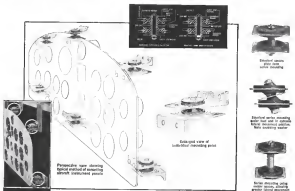
Mounting No. 1 shows mounting arrangement used in the top of panel, the lower unit being fastened to the panel or supporting member and the upper unit to the supporting member.

Mounting No. 2 shows arrangement used at bottom of panel, the upper unit being fastened to the panel or supporting member and the lower unit to the supporting member. Mounting arrangement may be varied to suit conditions.

The use of isolating washers is shown as recommended. They prevent contact surfaces under shock loads, either vertically or horizontally, without interfering with normal operation. They also furnish an interlocking system of metal, providing a factor of safety.

To install **LORD Mountings** in series, provide reinforced hole $1/16"$ larger than rubber diameter in both the supported and supporting members, for clearance. Drilled, punched or tapped holes should be provided and bolts, screws, or rivets used for fastening.

Complete information on dimensions, load ratings and methods of installation are contained in our Bulletin 104. Send for your copy.



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Originators of Shear Type Bonded Rubber Mountings



Walde Triuarc presents a significant advance in retaining rings. It spreads or contracts without distortion, always retaining its perfectly fitting circular contour. For all thrust-load fixing, shaft and housing applications, Walde Triuarc

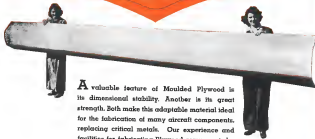
provides distinct advantages over nuts and bolts or wedges and washers. It reduces distortion and weight, saves material, cuts manufacturing time, simplifies assembly and disassembly. On request, we will gladly furnish samples and full data for your tests.



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THE NAVIGATOR signs later fully, then speaks to his assistant below. It's the final fix and the lines on the dial. In chart and compass — at Tania! They've overt, and several later — "TARGET!"

True, it's not as simple as it sounds, and shooting the stars with the

Vern Compass shows the task and makes celestial observations that are exceedingly precise and reliable. By facing pointers, from the landmarks of the sky with the Vern Compass and other celestial navigation equipment our boys know exactly where they are and where they're going. Clearly in command we can navigate the station for when the stars above say "target," it's a target map below.

The wonder of the horizon and

or celestial navigation are daily in the service of our Air Forces. Serving on those aerial fronts is the Vern Compass made by Boes. Because its duty is so vital because it is the single guide to safety and success, this compass is made as true, as precise, as reliable as the hands of man can make it.

The same may be said, we believe, of all electrical and navigational equipment that we are privileged to produce for the Armed Air Forces.

Landmarks of the sky say "TARGET!"



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In these a dollar in your pocket that should be in the field? Put it in Boes' hands today.

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Now . . . SPARTAN is a greater "University of Aviation" than ever! This school's department of aeronautical engineering—already acclaimed for its fine equipment and technical training—has been given full recognition as a COLLEGE OF AERONAUTICAL ENGINEERING.

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You say—

- "Less wear on cylinders,"
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- "Level of consumption."

What you've said is—

- "Longer engine life and more efficient performance."
- That's what you get with PORUS-KROME.

PORUS-KROME is a precision process of applying hard chromium, of controlled porosity and smoothness, to exclude films of internal combustion engines.

Europe knows it well, uses it widely. That is where this process originated . . . in Holland, England and Canada know and use it, too. And America is learning fast. PORUS-KROME is a going operation here, now, for military purposes.



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AVIATION, June, 1941



Everywhere in Aviation

—Snap-on tools are on the job . . . helping build America's finest planes . . . and playing an important part in producing the mighty engines that power them . . . Snap-on are used in manufacturing their propellers . . . and in making the precision instruments that help guide them. Snap-ons are widely chosen to maintain them . . . to keep them flying on every flaming battle front of the United Nations. Snap-ons are distributed to America's key aviation centers through 33 strategically located factory branches. Write for catalog and address of the nearest branch.

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THE CHOICE OF BETTER MECHANICS

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All types of tires and tubes, airplane wheels and brakes
Bullet-puncture-sealing fuel and oil cells • Bullet-puncture-sealing fuel hose • Flexible connections for fuel lines • Gaskets • Sheet packing • Straps • Fuel and oil tank fittings and gaskets • Brake seals, boots and cups • Three sheets (for forcing grease) • Coolant hose • Hydraulic control hose • Hydraulic accumulator diaphragms and gaskets • "U" "V" "O" type packings • Engine mounts • Interconnector hose • All types of molded goods • Life rafts • Life vests.

less in our production of accumulator diaphragms, all types of oil-tight packings, hydraulic hose and fittings, bullet-puncture-sealing fuel hose—all made with our own synthetic rubber, Chemigum.

And there are many others, including the new Goodyear vibration-dampening engine mount for largest type power plants, the new Goodyear Ice-Gripper airplane tire for arctic operations, self-indicating rubber life rafts,

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ALTHOUGH employing a different technique, the foundryman, like the silversmith, produces quality through passionate workmanship. • In the Wellman plants another characteristic of the true craftsman—pride in work—is evidenced by the fact that a large number of fathers and sons are found among our employees. • High standards in patterns and castings are further secured by modern facilities, rigid inspection and capable experience. • Castings in Ampco Brosses, Downmetal (magnesium), Wellcast Brass, Bronze and heat-treated Aluminum Alloys. • Patterns of all sizes, kinds and designs, in metal or wood.

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AVIATION, June, 1941



MOSQUITOES MOVE THE MAIL TO MALTA

Every day, twin-engined high-speed Mosquitoes streak across Europe between England and Malta so fast they're out of sight before interception is possible. Flights aren't scheduled nor

do they take regular scenic routes yet they're plenty exciting!

The tales these Mosquito pilots will tell after V-Day will be more thrilling than any ever told by pioneer pony-express riders of the western plains. Fastest bomber in the world, the de Havilland Mosquito, like many other combat-proven aircraft now being built in Canada, is ADEL-equipped.



de Havilland Mosquito

ADEL PRECISION PRODUCTS CORP.
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SPOT THIS PLANE AND YOU'LL
SPOT ADEL EQUIPMENT!



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SEE BOMBS FOR VICTORY

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Battle Proven Trench Warfare Through Battle Lines

Heck to handle pounding surf—made to stand the jarring impact of landings—strength is the word for these barges. And tough is the word for the giant gears that drop their anchors and raise them. In fact, so tough are the blunks for these gears that cutting them was deemed an impossibility. Force Bros. engineers and Force Bros. workmen changed the conception of what was possible. And today, the landing barges which are keeping Hitler's armies pinned to the coast from Narvik to Tripoli

Here at Foote Bros. new techniques and new manufacturing know-how are responsible for gears and speed reducers of radically different design and construction—gears lighter in weight and of extreme precision for aircraft engines—gears of giant size and superb finish designed to stand the grueling punishment that only war can give.

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Skilled hands
and
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Simply peel precision adjustments

Laminova turns place quick pre-
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laminations (each 3/32 or .031
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Peeked or unpeeled, Laminova
always presents a glossy smooth
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LAMINUM

— *See* **vacuum**

which will
times and newspapers in
Consolidated's contribution toward a
clearer public understanding of
"aviation geography."

A black and white illustration of a globe. Overlaid on the globe are several curved lines representing flight paths or great circles. A compass rose is positioned at the top of the globe, with its lines extending downwards. The globe is surrounded by stylized clouds. The overall composition suggests global connectivity and aviation.

**No Spot on Earth is More Than 60 Hours
From Your Local Airport**

were moved and dropped the three weeks to 10 days. As you can see, it would seem almost as if we had failed.

on 2004.3.14

On look at one of the new "green" or "organic" apples, like those one children are studying in school. These apples make children the magic we have always known. They show us the world as it really is in this world, because of the place. There is no more (and your house grows in London, Moscow, and Shanghai. Newton and people we were through stress and now merely stress and stress and stress.



How Abilene Works: *See How It Works* on the [Abilene website](#) for more information.

Today, of course, the global sky-ways are crowded for exactly the same reason, where freedom of the air permits trade and mobility plans will become as much a part of everyday life as the use of cars, trucks, buses, railroads, and ocean liners. It is no demand of the future to create an global transportation to giant planets which fly almost with the speed of sound itself. For today, such plans are being designed, and are undergoing

[illegible]

In addition to the "big ones," General dated V-12s also built the VAIAM (Vietnam military training plane), the VENGAGE, Silver Hammer, 13

¹¹ Indeed, we see Flying at night had been passed from Chinese to Europeans via the Xanadu Club. Flying it was mentioned in the first issue. Flying itself through the air and across the President's address in Congress, Jan. 7, 1792.

Major General "Jimmy" Doolittle was the first American aviator ever to take off, fly, and land "blind." He did it in 1929 piloting a General Motors airplane equipped with a gyroscopic horizon.

Is the Commission's Volume plan as follows:

23

so that man
may fly....
safely



Not with a flying machine alone can man succeed in completely conquering the air. The vacuum tube engineer for example has contributed much to the flight of man.

Radio communications, instrument landing devices, cross-country beacons and other new and secret electronic equipment are as important to modern air travel as the wings, motor and fuelage. The thing that makes these devices function is the vacuum tube.

Electronic tubes have grown up in the service of aircraft. Overseeing the key sockets in the ground stations of practically every airline... in instrument landing devices... and now during wartime in the vital (concealed) equipment for the armed services of the allied powers.

Electronic engineers have the experience, knowledge and the product to render superior service to the aircraft industry... a fact to be remembered while you are drawing the plans for post-war mastery of the air.

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Camloc high-speed fasteners offer unusual flexibility for application on both metals and plywood.

REMOVABLE STUD ASSEMBLY—Permits adjustment for eccentricities, tolerances, etc. Available with fiber shafts or wing head.

SEALING CAP—For sealing against dust, oil and moisture up to 40 lbs. pressure per square inch.

SIMPLE HOLE MOUNTING—Quick, easy sheet preparation and bracket installation.

BRIST TYPE MOUNTING—Where single-hole mounting is impractical. Also for field service and interchangeability.

BRACKET TYPE MOUNTING—For installations at right angles to cover sheets, such as sides of junction boxes, etc.

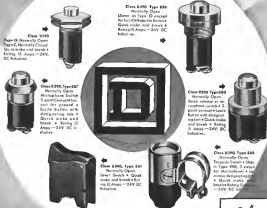
® U.S. Pat. 2,418,118

A catalog containing detailed information will be sent on request
Camloc Fastener Corporation, 429 Lexington Avenue, New York, N.Y.

ATTENTION June, 1945

Finger-Tip Control

with SQUARE D AIRCRAFT PUSH SWITCHES



Class 9190 Type 986

Normally Open
Mount on Type G except
for fixed tab in front
Quick make and break •
Rating: 15 Amps—24V DC
Inductive

Class 9190
Type 987
Normally Open
Quick make and break •
Rating: 15 Amps—24V DC
Inductive

Class 9190 Type 987

Normally Open
Mount on Type G except
for fixed tab in front
Quick make and break •
Rating: 15 Amps—24V DC
Inductive

Class 9190 Type 988

Normally Open
Rocker release or
compressor switch • 3
point contact • Low
friction with detent
motion • Quick make
and break • Rating:
15 Amps—24V DC
Inductive

Class 9190 Type 981

Normally Open
Reset Switch • Quick
make and break • Rating:
15 Amps—24V DC
Inductive

Class 9190 Type 984

Normally Open
Toggle Switch • Also
in Type 985, 3 contact
for dual control • Low
friction detent motion
• Quick make and
break • Rating: 15
Amps—24V DC
Inductive

AIRCRAFT Control DEVICES

Square D's shipping and handling is even more extensive variety of equipment for the aircraft industry. Precision aircraft switches are type switches, driven by the Kollman Design • circuit breakers, contactors, variable resistors and similar devices by the Detroit Edison Company and the General Electric. A low cost, reliable, the absolute best! Products for the aircraft industry are sold through Square D branch offices located in 89 principal U. S. and Canadian cities.



Class 9190—Type A
CIRCUIT BREAKER



Class 9190—Type 86
MAGNETIC CONTACTOR



Class 9190—Type 905
ANTENNA SWITCH

These devices are designed for aircraft control where compactness is an absolute requirement for push operations. Flexible in mounting use, this line has a wide range of aircraft applications.

Write for descriptive bulletins giving complete data on any or all of the devices illustrated.

SQUARE D COMPANY

DETROIT-MILWAUKEE-LOS ANGELES
KOLLMAN INSURANCE DIVISION, BIRMINGHAM, NEW YORK
100 WALL STREET, NEW YORK 5, N. Y. POWER UNIT, TORONTO, CANADA



Rings of Iron against Nazi and Jap!



EVERY GUN,
TANK AND
SHIP IS HALF
SCRAP, SEND
YOUR SHOP
SCRAP TO
WAS.

Behind the man behind the gun engines must function faithfully. For these engines Sealed Power is making piston rings, pistons, cylinder sleeves—making them precisely to the designers' specifications—24 hours a day—trying to make them worthy of the hard fighting soldiers, sailors and pilots who will depend on them for power. Wherever the United Nations fight you're sure to find Sealed Power engine parts in tanks, army trucks and jeeps, in pursuits, interceptors and bombers, in torpedo boats, destroyers and submarines.

SEALED POWER CORPORATION

Marquette, Michigan • Windsor, Ontario

PISTON RINGS—PISTONS—CYLINDER SLEEVES

VICTOR



The more sensitive hands of women welders appreciate particularly the fine balance and the flame characteristic of Victor welding torches.

VICTOR EQUIPMENT COMPANY
844-856 FOLSON STREET - SAN FRANCISCO, CALIFORNIA

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PACKS THE

Punch

WHEN YOU NEED IT



A G-E POWER PACKAGE THAT DRIVES LANDING GEAR, BOMB DOORS, WING FLAPS, AND TAIL WHEELS

Light, Compact, but Plenty Tough
Careful design, fine materials, and rigid tests—all contribute to the building of an electric drive that packs the punch you need—when you need it.

A superior insulating technique makes the winding structure practically indestructible—even under the severest overloads. The finest magnetic materials available are used to make sure that these G-E power packages will deliver top-notch performance under the most adverse conditions.

*Once designed and manufactured by General Electric, Inc., Boston, U.S.A.

Complete Unit—Ready to Install
The power package shown consists of an aircraft electric motor with magnetic brake, reduction gears*, and friction clutch. To keep the number of its moving parts to the minimum, each element is reduced to its simplest terms.

To Designers

This line of power packages can be a great help in simplifying your work. Instead of spending hours co-ordinating the devices that make up a drive, specify a

G-E power package. Remember too, these drives save man-hours on the assembly line.

When you have a new design under consideration, see the nearest G-E office about the possibility of adopting an available power package to your application. **General Electric Company, Schenectady, N. Y.**

GENERAL  ELECTRIC
Since 1879



NEW! CLECO RIV-N-JECTORS CUT RIVET LOSSES 90%

Riv-N-Jector is held in the left hand without hammer in the right, second. In driving, left hand can steady the tool, insuring accurate work.



The cost of performing rivets which have been dropped or misred in stock varies from 75% to 125% of the original purchase price. Out of 3 rivets misred to the operator, often only 1 is driven home, while the other 2 are wasted.

Cleco Riv-N-Jectors (patent pending) afford the perfect solution to this costly, wasteful problem. The Riv-N-Jector has a magazine holding about 50 rivets, which can be released one at a time into the rivet hole. Slight pressure of the fingers releases the rivet, while another rivet feeds down for insertion in the next hole. Riv-N-Jectors are easily loaded by a hopper-loader.

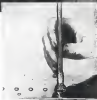
RIV-N-JECTOR ADVANTAGES

Less Waste—Using a Riv-N-Jector, the operator only loses 2 or 3 rivets out of 50, compared with loss of more than half when handled by hand—a 90% saving!

Greater Speed—With Riv-N-Jectors, operators often insert and drive 30 rivets per minute.

Easy Operation—Operators learn to use Riv-N-Jectors practically at a glance, at the end of the day they are experts.

No one engaged in airplane fabrication can afford to be without this remarkable device. For complete information, write for Bulletin 33.



Inserting a rivet with the Riv-N-Jector.



The Riv-N-Jector is feather-light, easy to handle.

BUY U.S. WAR BONDS AND STAMPS

THE CLEVELAND PNEUMATIC TOOL COMPANY

Branch Offices in All Principal Cities

CLEVELAND, OHIO



PLASTIC PASSES THE AMMUNITION...with 58 Pounds Saved!

That saving in weight is mighty important to a fighter pilot. It makes possible an extra 178 rounds of .30 caliber ammunition... or 9 extra gallons of fuel... or the carrying of a life-saving rubber raft including installation weight and emergency rations.

Equally as strong as those made of metal, plastic ammunition boxes are 45% lighter, and make possible a saving of 58 pounds in a single engine combat plane.

These strong lightweight boxes save money, too. The use of a special laminated paper plastic developed by McDonnell permits a saving of 20% over the cost of comparable metal ammunition boxes.

We are prepared to handle additional plastic production contracts on aircraft parts such as ammunition boxes, gun turret parts and propeller governors. Please address all inquiries to PLASTICS DIVISION.

McDONNELL Aircraft Corporation

Manufacturers of PLANES · PARTS · PLASTICS · SAINT LOUIS · MEMPHIS ·

for the **WAR PROGRAM**



M-R-C
ROLLER BEARINGS
Special for
AIRCRAFT ENGINES

MARLIN - ROCKWELL CORPORATION . . JAMESTOWN, N. Y.



They know how to win air battles

Speeding down Hyland production lines, today, are precision-made aircraft controls of many types, from landing gear to flare release parts—and they're getting into the fight faster because Hyland employees understand the value of precision workmanship. They know, precision speeds production to win air battles. And it's air battles that Hyland employees and thousands of other American aircraft workers are really out to win!

If you are not already using Hyland control equipment on your aircraft, or even if you are, it will pay you to investigate Hyland products and facilities. Write, phone or wire today for the new, illustrated Hyland catalog—"Aircraft Control Equipment," Hyland Machine Company, Dayton, Ohio.



Hyland employees are proud of this flag. It displays the united loyalty of every worker.

HYLAND MACHINE COMPANY
 DAYTON, OHIO



**SINCE 1928, aircraft parts
 have been our business**

The Hyland Machine Company was organized to manufacture aircraft parts and supplies for the Army Air Corps. That was in 1928. Since then Hyland has successfully fulfilled government orders and subcontracted many leading aircraft manufacturers. For details on Hyland aircraft measurement control equipment and manufacturing facilities, see the new illustrated catalog.

Export Representatives:
 Van American Engineers & Exporters, Inc.
 250 Broadway, 25th floor
 New York City

Write for the new
**Hyland Catalog
 TODAY!**



In the sky or on the ground you can depend on

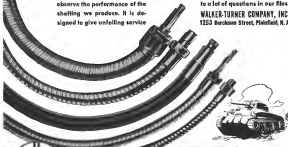
WALKER-TURNER FLEXIBLE SHAFTING

MANY of the mechanical weapons of this war are "quicker on the trigger," because of WALKER-TURNER FLEXIBLE SHAFTING. Its action is as positive in the stratosphere as on land.

As one of the largest manufacturers of flexible shaft machines for industry, we have had ample opportunity to observe the performance of the shafting we produce. It is designed to give unfailing service

under the most difficult operating conditions. That is one reason why aircraft manufacturers, and others who use flexible shafting for important applications, specify "Walker-Turner"

If you have a problem in remote control or power transmission, get in touch with us. We have the answers to a lot of questions in our files. WALKER-TURNER COMPANY, INC. 1253 Burkness Street, Plainfield, N. J.



FLEXIBLE SHAFTING

FOR REMOTE CONTROL AND POWER TRANSMISSION

Performance Plus!

WITTEK AVIATION HOSE CLAMPS

Now Made of Noncritical Steel

Wittek Types FBC and FBCA For Dependable Hose Connections

Made of noncritical mild carbon steel and zinc plated for corrosion resistance, Wittek Types FBC and FBCA Aviation Hose Clamps have performance characteristics comparable to those that were obsoleted with stainless steel construction.

Wittek Aviation Hose Clamps, known as the standard of the industry since the beginning of modern aviation, are now being used by the nation's leading military aircraft and engine builders. Wittek FBCA Hose Clamps meet all requirements of Army Air Forces Specification 25529. Wittek Manufacturing Co., 4105-15 West 24th Place, Chicago.



FOR MORE WAR SONGS

North American sets the pace with two short races that are making Mustang fighters, both equipped with Wittek Aviation Hose Clamps, are along to see to the Air. — with their confidence growing of many ships, parts, military clamps, planes and airfields.



Secure, leak-free connections—Pressure of 210 lbs. per square inch applied inside hose without leakage.



Secure, leak-free connections—Pressure of 210 lbs. per square inch applied inside hose without leakage.



Secure, leak-free connections—Pressure of 210 lbs. per square inch applied inside hose without leakage.

All tests conducted in accordance with Army Specification 25529, April 16, 1942, and made with Wittek Type FBCA Hose Clamps and 1 inch 30 hose.

WITTEK

Aviation HOSE CLAMPS

LADISH

quality

DROP FORGINGS



Ladish leadership in drop forgings springs from the sharp focus of its superior experience and technical talent on the constant target, "Quality." Unswerving facilities under constant metallurgical control produce forgings meeting uniformly, the most exacting engineering requirements.



LADISH DROP FORGE CO.

PLANT AND GENERAL OFFICES: CUDAHY, WISCONSIN

ENGINE VALVE COVER

NOTE 1: Parts to be machined to $\pm .002$

NOTE 2: To be Aluminum Alloy 24S

NOTE 3: To be finished in accordance with Army and Navy Specifications AN-QQ-A-6966a

"What's meant by that?"

ALCOA HAS THE ANSWER

There are several Government-approved oxide-coated finishes for aluminum, which may be applied by the Aluminite® process. Each has its own identifying symbol and name. You'll certainly run across them in your war work, if you're making aluminum plane or instrument parts which require protective finishes.

Some of the finishes serve as base coatings for paint, providing surfaces to which the paint is highly adherent. All offer increased resistance to corrosion. Some look like uncoated aluminum.

*Patent pending

Some are colored or black.

If you are stymied by lack of information on Aluminite finishes—what their symbols and names mean, where the finishes should be used, how they are applied—get in touch with us.

Or, if you're puzzled with some question about aluminum alloys and their fabrication, come direct to us, too. Alcoa engineers have spent a lifetime finding the answers to just such questions. ALUMINUM COMPANY OF AMERICA, 2112 Gulf Building, Pittsburgh, Penna.

ALCOA ALUMINUM

ALAT1105, June 1947



Pledged to all-out aid to America's fighting forces, NORMA-HOFFMANN is devoting all its resources and its 32 years' experience to the production of PRECISION BEARINGS for Army, Navy and Air Force units

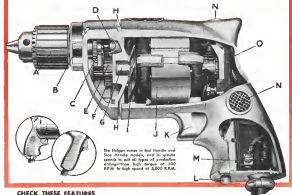
BUY WAR BONDS

NORMA-HOFFMANN BEARINGS CORP'N., STAMFORD, CONN., — FOUNDED 1911
PRECISION BALL, ROLLER AND THRUST BEARINGS

The **INSIDE STORY**

of the famous **Black & Decker HOLGUN**

—most widely used electric tool in the aviation industry!



The Holgun comes in full handle and size variable models, and its variable speeds in all types of production drilling—from high torque at 350 R.P.M. to high speed at 3,000 R.P.M.

CHECK THESE FEATURES

- A — Heavy-duty built-in 2-year ground protection check, threaded on spindle.
- B — Deepgroove ball-bearing on chuck spindle with inner and outer coils locked in place. This feature maintains easy, tension greater spindle accuracy and eliminates maintenance.
- C — Splined coupling of spindle gear increases strength, facilitates inspection, reduces wear, friction and wear. Spindle and gears are of heat-treated alloy steel.
- D — Double rubber bearing on back and of spindle.
- E — Full size variable plate, with 12 teeth, means smooth, balanced operation, low wear and longer service.
- F — Shallow intermediate gear, full bearing mounted inside the gear.
- G — Gearless drive, double gear-mounted full-bearing on sensitive shaft.
- H — Single 1/2" collet pin general gripping of new fitting types.
- I — Full size has mounted on sensitive shaft.
- J — Powerful Black & Decker General Safety through hole held firm securely.
- K — Power "Hold One & Trigger Switch" horse release with control on handle for left or right hand use.
- L — Double locking pin for optional use on continuous operation.
- M — Spindle automatic reverse switch. The switch, holding pin, and gearmotor and 2-inch cable are mounted in handle in one complete unit.
- N — Drive mounted on belt, any one of which provides single verification.
- O — Break holders and springs equipped on mounted automatic break ring, locked in place by split handle.

THE **BLACK & DECKER HOLGUN** is positively "standard" in the industry today. Always the leader in engineering development, Black & Decker suggests offer in America's favorite electric drill a light, compact package of power—with pistol grip and trigger switch—designed for high speed work in close quarters and built to "take it" under extreme operating conditions. The **HOLGUN** of Power **HOLGUN** is available in speeds for all kinds of drilling that mean greater production, longer service, lower maintenance cost, less operator fatigue (especially among women war workers), less interruption to vital production of planes, tanks, ships, guns and other weapons of war.



Expert Help—Quickly

For sound advice on all electric tool problems, call on your Black & Decker Distributor. He'll give you dependable, convenient source of supply and tool information — and he's always ready to help. The Black & Decker Mfg. Co. 719 Pennsylvania Ave., Towson, Maryland.

LEADING DISTRIBUTORS EVERYWHERE SELL

Black & Decker
PORTABLE ELECTRIC TOOLS



DUMORE GIVES *the* BOYS A BRAKE

FOR SPLIT-SECOND RESPONSE



FROM VITAL CONTROLS DEPEND ON DUMORE

He's your son or brother . . . or the lad next door, perhaps . . . and he's up there in a bombing trainer, preparing for the day when he'll plaster Tokyo. He's working hard . . . landing and taking off, landing and taking off . . . hour after hour, day after day. The wing flaps on his plane are air brakes for his landings, and they must be right . . . ready for split-second response. When the old type motors, even mounted two in tandem, couldn't stand the gaff, Dumore engineers were called on to design a new electric motor to operate the wing flaps on these planes . . . one that would deliver more than the combined horsepower of the two formerly

used. The compact new Dumore unit they created is a typical example of more than 30 types of aviation motors produced by Dumore Laboratories. These Dumore Motors power everything from ammunition booster units to condensate pumps, from bomb bay doors to windshield defrosters . . . aerial cameras, retractable landing gear, antenna reels, anti-icer pumps, oil cooler exit flaps and many other vital accessories. A Dumore Aircraft Motor catalog and complete information on Dumore engineering service are yours on request, without obligation.

THE DUMORE COMPANY, RACINE, WISCONSIN

Dumore
FRACTIONAL HORSEPOWER
AIRCRAFT MOTORS

FOR EXTRA POWER HOURS * * *

Inside this package  there's something important...



...the KLYSTRON* tube
developed by Sperry

UNTIL the war is over, there are very few things that we can tell you about the KLYSTRON* tube.

We can say that it is a vital factor in electronics, that it was developed by the Sperry Gyroscope Company following initial research at Stanford University.

Right now, the KLYSTRON* is making very important contributions to essential military equipment. And other advances in this field have been made—after the war is over, some of these will undoubtedly contribute to the security and comfort of a world at peace.

SPERRY

GYROSCOPE COMPANY

BROOKLYN, NEW YORK
DIVISION OF THE SPERRY CORPORATION

The name KLYSTRON and KLYSTRON are officially registered at the U. S. Patent Office as Division 1, 250, to Sperry Gyroscope Company, Inc. KLYSTRON is a registered name No. 274452. REINTEGRATION is a registered name No. 274453.



U-S-S Carilloy
dependable
Alloy Steels



**THEY'RE FITTING STEELS
TO MEET THE GRIM NECESSITIES
OF WAR**



IT is to help you speed the war program that the lights are burning late in our steel production and research laboratories.

More than 1200 metallurgists and trained technicians are working here. Their most important job today is to adapt steels to the rigorous demands of war economy and war-time production. They are on our payroll but they are working for you.

Their knowledge and experience

contributed to the development of the National Emergency Steels that have made it possible to meet the unusual conditions imposed by the shortages of nickel, chromium, molybdenum, vanadium and other strategic alloys.

They have helped to write new recipes for lean alloys, steels that provide the required qualities without excessive use of alloying elements. They've proved that you can sub-

stitute one alloy for another to achieve initial economy results.

They've made thousands of experiments that show not merely what these steels will do, but how you, who must use them, can fabricate and heat treat them to give the best results in service.

The mass of new technical knowledge these men have turned up is vitally important to you. We gladly place it at your disposal. Properly used it can be of real help in applying the steels now available, with greatest efficiency and least waste of time and labor.

CARNEGIE-ILLINOIS STEEL CORPORATION
Pittsburgh and Chicago

Chicago's Steel Company See Engineers, People, Costs, Advantages

United States Steel Export Company New York

UNITED STATES STEEL

DEATH LEAVES A FINGERPRINT

Probably it was hot and humid in the assembly room... that day when wars, prospective fingers evidently touched a tiny, needle-pointed shaft. But the fingerprint remained... and, conclusive...

A subzero—this accidental fingerprint? You—for on a later day that tiny part, weakened by corrosion, may fail—in a submarine depth-gauge, an airplane altimeter, or in any of scores of delicate military

instruments. And just because of a fingerprint, a sure way the

warrior can get his air conditioning. Where, precision is the trade, as when men's lives depend, air conditioning makes a proposition... offers out dust... helps speed output.

And this is but one example of how General Electric air conditioning and industrial refrigeration may serve the

war effort. To meet the exacting requirements of these wartime applications, General Electric is producing equipment that is highly efficient, reliable... compact.

When peace comes, this improved air conditioning equipment... by General Electric... will be available to all.

General Electric Co., Air Conditioning and Commercial Refrigeration Dept., Division 610, Bloomfield, N. J.

Air Conditioning by
GENERAL ELECTRIC

AVIATION • JULY 1945

AIR SUPREMACY AT HIGH AND LOW PRESSURES HANSEN AIR HOSE COUPLINGS

Regardless of whether it's high or low pressure, Hansen P204-TITE air hose couplings are masters of the air. Air hoses and leaks are too expensive to be ignored, regardless of how big or small they may be.

Hansen Couplings will handle an extremely wide range of pressure, anything from 1 ounce, depending up to over 10000 pounds without leaking, and that makes an "air savings" of considerable volume. But there is much more to a Hansen P204-TITE coupling than "air savings." For these couplings are much easier and faster to operate. A single push of finger into automatic action, they are made and set in automatically locked on. To disconnect, simply use a little thumb pressure on sleeve piece in locked coupling is disconnected and air is automatically turned off, nothing to turn, twist or lock. Nothing to bleed, blow or stick. Full thread action eliminates twisting or locking of hose to bleed, blow or stick. Full thread action eliminates twisting or locking of hose to bleed, blow or stick. Full thread action eliminates twisting or locking of hose to bleed, blow or stick.

Hansen P204-TITE couplings save more than pay for themselves in speed, increased production, air savings and efficiency... need for new tool creating.

HANSEN MANUFACTURING CO.
1786 EAST 27th STREET • CLEVELAND, OHIO

Close-up
action of
coupling

MILLIONS—YET EACH A JEWEL OF PRECISION



★ To produce within the strict tolerances of aviation standards is our first requirement. But hard on its heels comes the wartime demand for mass production.

That is the contribution of The Dole Valve Company—manufacturing parts of precision far beyond the scope of every day production—nevertheless in immense quantities.

We offer engineering assistance in the development and production of aircraft valves, fittings and accessories.

Made in accordance with Army-Navy Aeronautical Standards

THE DOLE VALVE COMPANY
ESTABLISHED 1900
1881-1840 CROVE AVENUE, CHICAGO, ILLINOIS
AND BRANDED IN DETROIT • PHILADELPHIA
★
BUY U. S. WAR BONDS AND STAMPS

DOLE

AIRCRAFT VALVES AND FITTINGS

WATCHDOG



THE Civil Air Patrol flies many types of commercial airplanes in its watch dog job of patrolling the coasts of the United States. One of the famous "Watchdogs" is the dependable Lycoming-powered Stinson. For dependable Lycoming engines carry CAP members with increasing dependability. Lycoming can't let these men down and doesn't want another example of Lycoming at work!

**LYCOMING
AIRCRAFT ENGINES**

The Training Plane Engine of Today
— The Private Plane Engine of Tomorrow

Lycoming Engines, The Lycoming Corporation
Williamsport, Penn., U. S. A.



Question every fastening job



Mobile Refrigeration, Inc., Long Island City, New York, chooses P-K Self-tapping Screws for Assembly of Several Different Materials

1. Type A—Drives through steel angles into Mastic bearings.
2. Type A—Four screws in each of three adjustable hinge plates hold up a 150 lb door. Fastening it steel plate to back.
3. Type A—Two screws in each of three hinge bars. Fastening it steel plate to back.
4. Type A—Two screws in each of three adjustable door fasteners. Fastening it steel plate to back.
5. Type A—Fastens frame for door glass. Drives through steel into back.
6. Type A—Holds door against its glass. Drives through steel into back.
7. Type Z—Fastens chassis seat to base railing. Drives through Mastic into 3/4" angle iron.
8. Type Z—Fastens steel balls into steel angles. These screws are either coated to withstand various loading temperatures.



260 TAPPING OPERATIONS ELIMINATED ON EACH UNIT—

Man-hours and tools saved—Assembly made stronger with P-K Self-tapping Screws

Assembly of this high altitude test-and-calibration chamber for aircraft and electronic instruments was greatly simplified, and the product made stronger, when the maker wisely "questioned every fastening".

Of more than 200 fastenings required, about half are metal-to-metal, for which machine screws were formerly used. When these were replaced by P-K Type "Z" Screws, 260 tapping operations were eliminated. Since P-K Self-tapping Screws tap their own strong threads as they are driven, one easy operation completes the fastening. They save the man-hours tied up in tapping... they also eliminate grinding, breakage and replacement of hard-to-get taps.

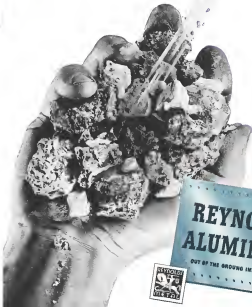
Assembly of the unit also involved a large number of metal-to-wood and metal-to-Mastic fastenings. Experiments showed that P-K Type "A" Screws would afford much greater security than the conventional wood screws which had been used. Stronger fastenings result because P-K Type "A" Screws are threaded all the way to the head, and are uniform in dimensions.

The problem made all the more and tool hours P-K Self-tapping Screws solve. Question every fastening job in your plant... visit our Giff in a P-K Assembly Engineer to help you work out all questions that apply P-K Self-tapping Screws. Or, mail assembly details for recommendations. Parker-Kalon Corporation, 192 Varick St., New York.



A TYPE FOR EVERY METAL OR PLASTIC ASSEMBLY

Out of the Ground Into Finished Parts for Planes



**REYNOLDS
ALUMINUM**

OUT OF THE GROUND INTO THE SKY



PARKER-KALON
Quality-Controlled
SELF-TAPPING SCREWS

Give the Trade Office 14 War Assemblies

SAVE MANPOWER .with Reynolds Fabricated Parts!

ROUTING With automatic precision, Reynolds new 12 equipped and skilled for all types of routing operations. All manufacturers have to do is supply the blue print and template. Reynolds makes the form and finishes you. Reduced cost and gain.

The armed services are calling more men every day. Farms and factories alike face a critical shortage of trained workers.

Manpower is the big problem this year . . . and Reynolds has prepared to help you meet it, like we are helping other aircraft manufacturers — by finishing aircraft parts at the aluminum source.

For over a year, we've been training women workers for our Parts Division in Louisville. Recently, we have expanded our parts' facilities — added 250,000 square feet of floor space for parts-making alone.

Now, as the result of this training and expansion program, we have immediate open capacity to finish flat and formed parts to your exact engineering specifications — to relieve skilled labor in your plants for other important work in aircraft factories.

Call our representative in your city. Tell him your individual parts making problem. Let us help you conserve precious manpower now.

SAVE PLANT SPACE

Under your present set-up you're probably using valuable space finishing parts and handling and storing scrap in your plants — space that you need . . . that you could use immediately . . . in your assembly operations.

With finished aluminum parts flowing to your assembly lines direct from Reynolds, you save this floor space for important work that cannot be done outside your aircraft plants.

Yes, and you save vital tools and critical machines, too. Often Reynolds finishes identical parts for several manufacturers making the same planes, thus eliminating the necessity for high-cost small volume work at aircraft plants.

SHEARING At the head of aerospace engineering at Reynolds, we have a large capacity shearing operation. Equipment includes machines of 6, 8, 10, 12 and 14-foot power shears for handling required dimensions.

SAVE SCRAP HANDLING

REYNOLDS finished parts save the time, waste effort and needless expense now involved in handling and shipping scrap.

Under the Reynolds plan, scrap from routing, shearing and blanking is free from contamination and is immediately re-routed into prime sheet. Overnight, the scrap is put right back into more parts to increase our production for you. In these days of tight shortages, this vital scrap is never allowed to be idle. It's in production all the time.

Needless cost-holding is eliminated, freeing hundreds of freight cars every year. In figuring prices on aircraft parts, Reynolds allows plane manufacturers the full selling prices for scrap accumulated. This saves the entire cost of handling scrap.

Your whole operation is simplified and more efficient. You buy only what you can use . . . finished aircraft parts. And you get more of them . . . faster . . . to meet your stepped up schedules.

FINISH PREPARED For months, Reynolds has been adding female parts facilities and training women operators. Now, with a reservoir of trained women, we can handle as much greater volume of this special lot.



INSPECTION Reynolds finished parts meet the same high standards as Reynolds Aluminum itself. Every part is meticulously inspected at various stages in the process of fabrication and in the final inspection department before shipment. Every part is inspected, as well as Reynolds' inspectors, one on the job will be there to make certain that each of the many uses of Reynolds' aluminum and physical properties, size, hardness and surface.



ANODIZING AND FINISHING To make its delivering service complete, Reynolds has anodizing, dyeing and painting facilities and has installed precision for these operations. Thus, this service takes away parts-making headache early from aircraft manufacturers.



GAINT PRESSING From thousands hourly turning out drilled products, Reynolds has obtained huge quantities of mechanical and hydraulic presses. These presses range from the smaller size to the 1200-ton giant.



NO SCRAP...
YOU BUY PARTS
READY FOR ASSEMBLY!

Facts About YOUR New Source of ALUMINUM

Virtually every warplane that you of the American aircraft industry are speeding to the fighting fronts, carries some Reynolds Aluminum into battle. Reynolds created a new source of aluminum long before Pearl Harbor, and today Reynolds is pushing a steady flow of this precious metal to your plants. Here are some of the things we have done...and are doing now...to help you win this war...and the peace to come...with more aluminum:

TWENTY YEARS' EXPERIENCE IN ALUMINUM: The two decades between world wars saw Reynolds piling up priceless experience, rolling light metal in tremendous volume. As America's largest aluminum foil producer, we rolled more square miles of light-gauge metal than any other manufacturer in the entire world.

SAW AMERICA'S NEED AND STARTED ACTION: Way back in 1939, when the Axis' aluminum output was twice that of the United States, Reynolds foresaw America's coming need and started action. We mortgaged all of our resources to expand our aluminum facilities.

MINED OWN BAUXITE ORE IN AMERICA: In 1940 and '41, when gray Nazi waves swept over France, Reynolds prepared. We started mining our own Bauxite in Arkansas. We built mammoth new plants to carry it through to finished metal, including one giant at Listerhill, Ala., where Bauxite flows in one side and aluminum sheet for aircraft flows out the other.

NEW SOURCE ROLLING WHEN WAR CAME: On fateful Dec. 7th, when the Japs struck, Reynolds was ready and rolling with virgin aluminum plants, rolling mills and rod mills of Listerhill, Ala. — with ingot molding units at Longview, Wash. — with sheet plants, rod mills, and extrusion plants in Louisville, Ky. — and with expanding sheet facilities at Richmond, Va.

NOW SERVING THOUSANDS OF WAR PLANTS: As America plunged deeper into all-out war, Reynolds dug deeper into its Bauxite pits and multiplied production manyfold. Now Reynolds alone is mining 36% more Bauxite ore than was mined in the entire nation three years ago. We're turning out hundreds of millions of pounds of aluminum to feed literally thousands of war plants. Our 37 factories in 13 states are operating 24 hours a day.

PREMIUM METAL... 99.85 PER CENT PURE: Reynolds uses the modern continuous electrode process. This simplified production helped raise the purity of the Reynolds product above the average of the aluminum industry. Today, 99% of the output of our newest plant is premium metal with a purity of 99.60% or higher. Substantial quantities are 99.85% pure.

VISION AND PRECISION FOR YOUR PROBLEMS: With this record of foresight and initiative, Reynolds offers the products and services of a great new independent aluminum source. We're ready now to analyze your individual aluminum needs — to give them the same precision planning and prompt action that has gone into the building of our own organization. Feel free to call on us now — and always.

REYNOLDS METALS COMPANY
General Offices, Richmond, Va.
Pitts Division, Louisville, Ky.
37 Plants in 13 States



PAGES FROM
AVIATION'S HISTORY

U.S. Army Flying Forces celebrating from a bombing raid on the main runway, Gen. Robert H. Goddard.



Reynolds Aluminum was the great 1930's in the aviation of the world. In the aviation of the world, Reynolds Aluminum was the great 1930's in the aviation of the world. In the aviation of the world, Reynolds Aluminum was the great 1930's in the aviation of the world.

MISSION ACCOMPLISHED

Hit fast—hit hard—get away fast! That's all there is to a successful bombing expedition. But—on takes split-second co-ordination of a finely trained crew and precision-built equipment, to produce such results. Emerson-Electric Aircraft Motors that drive gun turret, operate fuel pumps, oil controls, and do many other vital jobs—*instantly and unflinchingly*—are helping United Nations flyers all over the fighting world, return and report...“Mission Accomplished!”



LIGHTWEIGHT, COMPACT, POWERFUL—Emerson-Electric Aircraft Motors are made for gun turret drives, hydraulic units, fuel pumps, oil controls, waterways, communicating systems, also with built-in gear and limit stops.

THE EMERSON ELECTRIC MANUFACTURING CO.
SP. 19415...America: New York • Canada: Chicago • Los Angeles • Montreal

EMERSON ELECTRIC

MOTORS • PUMPS • APPLIANCES • A. C. ARC WELDERS

SAVE PRICELESS MAN-HOURS

by having us assemble
conduit and fittings



We have a large assembling department, staffed by experts, who will assemble fittings and flexible shielded conduit to your own specifications. Every hour of assembling time saved is an hour gained on your production line.

Send us the complete specifications and we'll tell you by return mail how we can handle your assembly to your best advantage.

American Metal Hose makes a complete line of fittings and accessories for American Flexible Low-Tension Shielded Conduit (some examples are illustrated above). Both fittings and conduit conform to A-N, A-C and NAF specifications.



AMERICAN METAL HOSE BRANCH OF THE AMERICAN BRASS COMPANY
General Offices, Watertown, Conn., Subsidiary of American Copper-Nickel Co.
In Canada: American Brass Ltd., New Toronto, Ontario

American Metal Hose

On his own... but never alone!

This might be your boy... or the kid next door. Yesterday he was a little shaver. Today, he's a full-fledged fighter on his own up there in the skies! Yes, he's on his own... but never alone. For riding with him in his plane are the radio-men of "The Invisible Crew" of Bendix.

With these special stretch radio devices, he talks with fellow pilots, and keeps in touch with comrades on the ground. He picks up distant radio stations to guide him on his course. He "sees" what lies ahead, even through impenetrable fog. And, as a matter of course, he uses new electronic devices far too confidential to talk about now.

Through these engineering marvels that guide and protect him, he senses secrets of the future... the future that he's fighting for.

**RADIO-MEN OF
"THE INVISIBLE CREW"**

These "Radio-men" have the ability to withstand anyone who so combines as a result of the outstanding efforts of the Bendix Radio Engineers. No doubt it too small to escape the grueling tests that require enduring patience and nerve. Numerous remarks can usually stage up already high performance to exceed every standard previously reached.

BENDIX

Back America's invisible crew... get together on aviation, radio, and defense equipment.

More than 50 Bendix plants are upholding the Radio Crew in world battle fronts.

B E N D I X R A D I O D I V I S I O N



Mexican "B-la-J"
Monometer in use
at instrument shop
of Pan American
Airways System
at the Marine Barr,
La Guardia Air-
port, New York City.

-BUT THEY "FLY" FIRST IN THE "LAB"!

Here in the shop, before flight, Pan American World Airways thoroughly checks the aircraft instruments of its famous Clippers with Memom. Manometers. Nothing is overlooked to assure safety. Pan American checks calibration with the Memom "B-1" Manometer (A-339, illustrated) to determine functioning of such aircraft instruments as Altimeters, Air Speed Indicators, Rate-of-Climb Indicators, Fuel Pressure Gauges, Manifold Pressure Gauges, Suction Gauges,

Automatic Pilot systems and actuating mechanisms, etc.

This is a direct reading Weld Type Manometer with an eight-sided scale selector, permitting the selection of proper scale for particular stress instrument being checked. It is widely used in both laboratory and field.

Ask for Bulletin 22 containing complete description.

THE MERIAM COMPANY
1001 West 110th St.
Cleveland, Ohio



Johnny's Got a Gun...

That's putting Tojo on the run!

Thanks to U.S.M.C. and the 3 P's*



It's the Reising Gun that's playing hob with the Rising Sun. Harrington & Richardson Arms Company of Worcester, Mass. is making this six and a half pound bit of lethal dynamite capable of shooting 500 shots a minute.

In spite of its simplicity of design and its ultimate effectiveness, this new sub-machine gun could have proved a production bottle-neck, for cutting rifling grooves used to be a slow mechanical headache. Now, thanks to the 3P's - Primary, Production, Precision* - The Lapointe broaching method, this is done with only one trip of a broach through the barrel, a matter of seconds instead of minutes.

Primary, Production, Precision* is broaching today. Now one single high speed precision operation mass produces hundreds of jobs that were formerly done by many antiquated machining operations.

For Primary Production Precision
consult Lapointe Broaching Method

≡ The **LAPOINTE MACHINE TOOL COMPANY** HUDSON, MASSACHUSETTS ★

NO..THE PLYWOOD PLANE DIDN'T COME FROM "Nowhere"

Twenty-seven years of aircraft plywood development are represented by every fighter, bomber, trainer, glider engineered with Roddis Aircraft Plywood. Since 1916 aircraft plywood has been the subject of constant research and development by Roddis engineers and craftsmen.

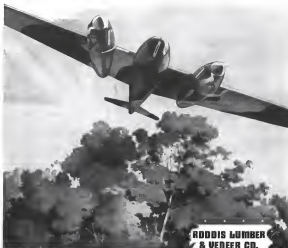
Out of these many years of research and experience has come Roddis Aircraft Plywood—a scientifically built, highly skilled product of assured quality and uniform character. It or even plane manufacturers is tested



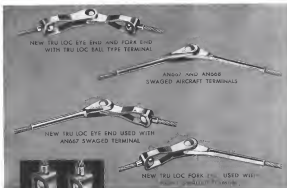
perfect ready for immediate application on production line operations—saving time and trouble—speeding output. Problems of plywood production solved yesterday, are reflected in today's constantly increasing use of plywood for gliders and gliders—a vital necessity if production

continues one to line and bettered Roddis Aircraft Plywood exceeds the rigid specifications of the Army and Navy in sheer strength and security to the elements. Made from carefully selected logs and produced on the most modern machines by craftsmen with a fifty-three-year heritage of skill in woodworking, it assures fighting aircraft the ruggedness to carry out their vital missions.

For information about Roddis Aircraft Plywood, see your local Roddis representative or write to us direct.



**RODDIS LUMBER
& VENEER CO.**
MILWAUKEE, WISCONSIN



**DON'T LET SLOW DELIVERIES
OF AN667 AND AN668 FITTINGS
STOP YOU—THESE NEW TRU-LOC
EYE END AND FORK END FITTINGS
ARE PRECISELY INTERCHANGEABLE
WITH THEM AND READILY AVAILABLE**

GET A COPY OF THIS NEW FOLDER. This data folder gives you the complete story of tru loc Eye End and Fork End Fittings—exact dimensions and all other essential data. It shows you definitely how to end at once any delays caused by the necessary slower deliveries of AN667 and AN668 Fittings. . . . To obtain a copy, write our Detroit office on your company's letterhead.

AUTOMOTIVE AND AIRCRAFT DIVISION

DEPT. TA, 6-233 GENERAL MOTORS BUILDING, DETROIT, MICHIGAN



A DIVISION OF AMERICAN CHAIN & CABLE COMPANY, INC., BRIDGEPORT, CONNECTICUT

ESSENTIAL PRODUCTS . . . TRU LOC Aircraft, Automotive, and Industrial Controls, TRU LOC Aircraft Terminals, AMERICAN CHAIN Wire Ropes, TRU LOC Brakes, AMERICAN Chains, WSD Tie Chains, WOOD Multiple Coatings, CAMPBELL Cutting Machines, FORG Hooks, Turnbuckles, RIGGING Wire Ropes, Roddy Ropes, HAWLEY Auto Service Equipment, CHERRY Springs, FAGE Hooks, Shaped Wire, Welding Wire, BEADING PLANT & CORD Values, BEADING Beams and Coatings, WRIGHT Bells, Cores, Purses. . . . In Business for Your Safety



1700 HORSEPOWER UNDER PERFECT CONTROL

—puts the Helldiver "on target"

CARRYING an 1800 lb. bomb load—powered by a 1700 h.p. engine—with a cruising range of 1200 miles, and a top speed of 300 mph or better, this heavy-hitting dive bomber is said to be capable of sinking almost any vessel afloat, all by itself.

The bull's-eye accuracy of its "run-in" on a target, and its swift maneuverability that disconcerts defensive fire are insured by American Tiger Brand Control Cables.

Their sure dependability and perfect functioning translate the

splinter-second decisions of the pilot into direct, instantaneous action. Their in-built qualities of high strength and high fatigue resistance, minimum stretch and superior flexibility, combine to give precise controls the sensitive response indispensable for precision flying and combat tactics.

Light in weight, highly resistant to abrasive wear, all American Tiger Brand Control Cables are of Excellent Performed construction. Here is the final assurance of flawless performance under every service condition.

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York

COLUMBIA STEEL COMPANY

San Francisco
United States Steel Export Company, New York

UNITED STATES STEEL

Illustration of several bundles of American Tiger Brand Control Cables, showing their braided structure and packaging.

AMERICAN
Tiger Brand
CONTROL CABLES

MASTER OF MANY CLIMES

You will find the Allison engine busy today in the tropic heat of equatorial regions, and the numbing cold of arctic areas. * You will find it striding the enemy front, the palm tops of jungle country and through the ground haze of the desert—you will meet it, too, in the sub-arctic temperatures of the upper air. * But wherever you find it, you find steady dependability doing a masterful job, carrying the fighting pilots of the United Nations successfully on their missions—then winging them safely home again.

* The Allison is manufactured under General Motors standards of engineering, metallurgy and fabrication. * Planned from the outset to be one of the world's finest aircraft engines, the Allison is living up to General Motors' purpose in creating it—and in the process proving itself master of every climatic condition under which men fight.

POWERED BY ALLISON
P-38—Lightning
P-51—Mustang
P-40—Warhawk
P-51—Mustang

Allison
DIVISION OF

GM
GENERAL MOTORS

LIQUID-COOLED AIRCRAFT ENGINES



KLIXON CIRCUIT BREAKERS Now Have Ratings as High as 200 Amperes

Another new Klixon Circuit Breaker... the PGM, with a 200 ampere rating... is now available, making possible even greater applications of Klixon protective devices for aircraft electrical circuits. Like all other Klixon Circuit Breakers and Protectors, the new PGM is unsurpassed in performance. While not affected by hazardous transient shocks, it does give you positive, foolproof protection against harmful overloads... and it is a permanent protective device, no replacements are necessary.

For its capacity, the Klixon PGM is compact, small, and light in weight. It is conveniently mounted on instrument panel. Has a push button, with or without luminous tip, for manual reset. And it performs dependably under all flying conditions. Write for further information.

Since April 30th, the Army-Navy "E" patent has been flying over our plant... over award for furnishing the Air Corps with many types of automatic thermomagnetic controls.



Klixon PGM Circuit Breaker. Ratings as high as 200 amperes. Weight 9 ounces.

Klixon PMT Green Protector. Ratings from 5-60 amperes at range of 5. Weight, 1 1/2 ounces.

Klixon PGM Circuit Breaker. Same mounting dimensions as model 100. And 200 amperes. Ratings up to 15 amperes.

Klixon PLM-11 Green Protector. Ratings from 25 amperes through 150 amperes. Compact and light in weight.

How to PREVENT THIS SABOTAGE to Your Screw Driving Army



PHILLIPS SCREWS END DRIVER SKIDS!

Caught in the act by the "iron" action photography* of Giese Mill, is a skidding screw driver... one of the thousands of laborers. Skidding drivers cause accidents that keep all too many workers away from assembly lines, causing gauged hands. And, fear of such injury slows down the work of countless others. Always present, the danger increases with unaided, inexperienced workmen. So, it's doubly important today to specify Phillips Recessed Head Screws... which prevent driver-skids!

Acoustical cushioning of driving force in

the scientifically designed Phillips Recessed Head screws... no other screw driving machine... the fastening, wobbly screw... no deriding of these driven screws... removal of broken-head screws... reclaiming of wasted parts. Fast, friction driving between operators' fingers, even for "green hands". Power driving becomes pinpoint.

They can't let us! Compare driving cost. You'll find that screw price is a minor part of total fastening expense... that it actually costs less to have the advantage of the Phillips Recessed.

*Giese Mill speedometer exposures with lightning-like flashes at the workmen's lights, to make skidding driver action be vivid and

KEY TO FASTENING SPEED AND SAFETY

The Phillips Recessed Head was scientifically constructed to allow

fast turning - Driver point automatically centers in the recess... no wrap up. Screw and driver "become one unit". Fastening, wobbly screws are eliminated. Faster driving - Recessed and power driving are made practical. Driver won't slip out of recess, so injury wastes no spell moment. (Average time saving is 50%.)

Twist Driving - Turning power is fully utilized by accurately cushioning of driver in screw head. Workers maintain speed without strain. Better Fastenings - Screws are set up uniformly tight, without burning or breaking heads. A vacuum, never job results.



PHILLIPS Recessed Head SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

21 SOURCES

American Screw Co., Providence, R. I.
The Brown & Sharpe Co., Providence, R. I.
The Brown & Sharpe Co., Weymouth, Mass.
The Brown & Sharpe Co., Weymouth, Mass.
The Brown & Sharpe Co., Weymouth, Mass.
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The Brown & Sharpe Co., Weymouth, Mass.

Phillips Manufacturing Co., Hingham, Mass.
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Experience

is a "Priceless Ingredient" in Making Heaters Work!



At heater school in Chicago, men with practical field experience from Army, Navy and Civilian service personnel in theory and practice.

4 Years of Actual Field Work Represented in Newest South Wind Heaters—and in the Men Who'll "Keep Them Heating"

ALMOST ANY HEATER can look awfully good... until it goes up against a winter in the field. Learning what won't work is a key step in learning what will.

For 4 years, Stewart-Warner engineers have learned side by side with the experts of the aircraft industry... struggled with them against the ever-changing problems aviation has had to solve. In laboratory, factory and field, we've been thru the mill.

And the records show that South Winds are performing—even under unforeseen conditions

—wherever the experience of our own field men, or of men trained by us, has been available.

To spread this "know-how" in every operating front, a steady flow of men is moving from the Stewart-Warner heater school... men thoroughly trained in all that experience has taught us about this new heating science.

Tomeorrow, whenever your planes fly, they'll find such men ready to make good the promise of "hotter heat—faster" that experience has enabled us to build to even greater degree into the newest South Wind heaters.

Service practice at school includes thorough practical work on heaters of all types.



South Wind HEATING EQUIPMENT

Heater Division, Stewart-Warner Corporation, Chicago
West Coast Office: Stewart-Warner Aircraft Heater Engineering and Service
1213 Westwood Blvd., West Los Angeles, California



A WORD TO THE CREW OF A BOMBER



**Delco-Remy
Aircraft Electrical Equipment**

With the sky as your battlefield, you have learned to conquer time and space. You have lifted your own and America's eyes to new horizons, and prepared this nation to make full use of the very air you are making free. ¶ Delco-Remy electrical equipment is used today in heavy and medium bombers. In days to come, it will be applied to meeting the requirements of commercial planes, while smaller Delco-Remy units will provide the convenience and dependability of electric starting, lighting and ignition for private planes. ¶ Delco-Remy's qualifications for serving the aviation industry are implicit in this fact: More than half of Delco-Remy's facilities are now engaged in the manufacture of aircraft electrical units, precision parts and products.

DELCO-REMY

DIVISION, GENERAL MOTORS CORPORATION



Add "AUTOMATIC" FORK TRUCKS TO YOUR PRODUCTION LINE
FOR FAST MOVING, HANDLING AND TRANSPORTATION

AUTOMATIC
Standard
VICTORY MODELS

Materials, parts, and finished products must be kept on the move from departments to depart ment—quickly, without waste of time, and at low cost. Transportation so important to the war effort begins right in America's plants—transportation that insures a steady flow. "AUTOMATICS" have won wide acceptance in all industries serving the war effort. "AUTOMATIC" representatives, fully experienced in the application of our Standard Victory Models, are ready to cooperate with you. These men are listed in the classified telephone directories in principal cities and industrial areas under "Trucks, Industrial".

MANUFACTURERS FOR OVER 31 YEARS Electric Propelled INDUSTRIAL TRUCKS

AUTOMATIC TRANSPORTATION CO.

42 WEST 37th STREET

CHICAGO, ILLINOIS

CHICAGO, ILLINOIS



Photo Courtesy Mac-Cormack Airlines showing current Wilcox machines

Uninterrupted Service IS Vital to Safe Air Transportation

Dependable communications are the keynote. There must be no failure. For years, Wilcox has made radio equipment to help carry on flight control safely. Today, the "know-how" of Wilcox facilities is entirely devoted to manufacture for military needs. After peace is secured, the marvels of radio development will be working for better living.

There MUST Be Dependable Communications
Communication Receivers Aircraft Radio
Transmitters, Equipment Aerial Radio Equipment



WILCOX ELECTRIC COMPANY

Quality Manufacturing of Radio Equipment
1418 N. CHESTNUT KANSAS CITY, MISSOURI

LEADERSHIP THEN AS NOW

The stock bearings of tomorrow are being blue-printed today. And the future will find the Bunting wholesaler ready to supply the bearings required by a new mechanical age.

Whirling within this Bunting Bronze Bearing is the propeller shaft of the 2000 H.P. Engine which powers the world's largest and fastest planes. This unique Bearing is an example of new and advanced methods used in the manufacture and application of Bunting Bearings for the great weapons of modern war. The Bunting Bronze & Machine Company, Toledo, Ohio. Warehouses in All Principal Cities.



Bunting
BRONZE BEARINGS • BEARINGS • PRECISION BRONZE RINGS

THE CUSTOMER GOT THE BOLTS!

Material Saved Critical Screw Machines Released A Stronger—Better Product

(Case History No. 3 from New Booklet)



This specially carburized bolt was originally made on screw machines. Unable to secure the required quantity, the contractor tried having it upset by the hot heading method, but this process was not satisfactory in forming the head to the required tolerance.

We developed a cold heading method, which consists of forming a round head and rolling the hex. The shank was required to be smooth, free of cracks or circular grooves, and our method proved more satisfactory than the screw machine method in attaining this result.

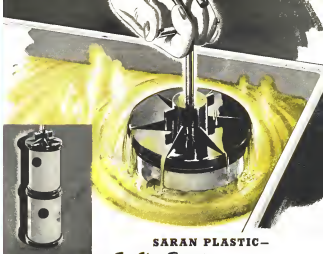
By eliminating the tedious operation of rolling from the bar, we stepped up the production rate to the quantity needed, released critical screw machines for other work, saved man power, reduced costs, and effected a reduction of 70 per cent in material used.



Send for new booklet
"Forming Critical Hex
Bolts, Screws,
Washers by Cold
Heading."

National
HEADED AND THREADED
PRODUCTS

THE NATIONAL SCREW & MFG. CO., CLEVELAND, O.



MASKING PARTS FOR PLATING OPERATIONS

Saran masking parts help speed production of cylinders and all machine parts. The entire outside diameter of the cylinder, illustrated here, is metal plated with the exception of one-half inch on top and bottom. Saran fitting rings, center and bottom saran masking plates, into which two sleeves are placed, provide complete protection. As a result, valuable time and material are conserved by the newest contribution of a superior plastic material.

SARAN PLASTIC—

*For Uses Requiring
High Chemical Resistance*

Saran's high degree of resistance to a broad range of chemicals is demonstrated by its successful use in plating masks and fixtures. This difficult application emphasizes Saran's distinctive position among plastic materials. For, in a series of exhaustive tests in many plating solutions and over normal operating temperature ranges, Saran proved its superiority.

Saran advantages go far beyond exceptional chemical resistance to include such important properties as excellent dimensional stability resistance to moisture and heat, and resiliency and durability. These factors make Saran for many new uses—extending from the electroplating industry to a wide variety of industrial applications.

THE DOW CHEMICAL COMPANY, MIDLAND, MICHIGAN

New York • Los Angeles • Chicago • Miami • San Francisco • London • Bombay

SARAN

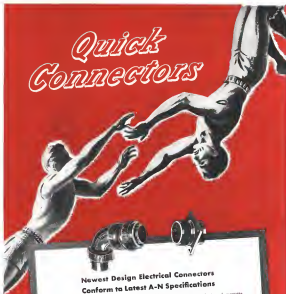
DOW PLASTICS

STYROL • STYRON

DOW

CHEMICALS INDISPENSABLE
TO INDUSTRY AND VICTORY

Quick Connectors

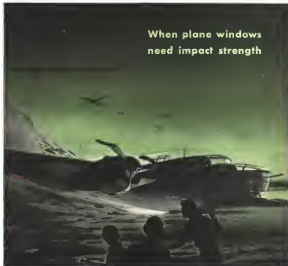


Newest Design Electrical Connectors Conform to Latest A-N Specifications

A dependable means of connecting and disconnecting many electrical circuits at once is vital to the operation and maintenance of America's warplanes, tanks, and PVT boats on fighting fronts the world over. The newest type Breeze Electrical Connectors, carrying loads 1 to 47 contacts, make it possible to make or break multiple circuits simultaneously, quickly and with safety. Connections are secured without vibration by threaded crimping and gas and solvent construction. Produced in a wide range of types and sizes, Breeze Connectors are designed to meet practically every need in modern electrical control and communications systems. Fully shielded against radio interference, these units conform to the latest A-N specifications, and are engineered to meet the highest standards of design and construction.

BREEZE CORPORATIONS, INC., NEWARK, N. J.

Breeze



When plane windows
need impact strength

Aero Quality
LUMARITH

has it

*The First Name
in Plastics*

**CELANESE
CELLULOID
CORPORATION**

It can happen anywhere—forced landing, airframe damage, perhaps—and the need for impact strength is ever so vital!

Aero-Quality Lumarith in cockpit enclosures, windows, and turret housings answers the need for a transparent plastic that can take the stresses and strains. It is shatter-proof, non-splintering. This special Lumarith formula has the additional property of intercepting the invisible light rays that can induce severe sunburn on long flights.

Celanece-Celluloid Corporation, 180 Madison Avenue, New York City, a division of Celanece Corporation of America Sole Producer of Lumarith® and Cellulith® plastics . . . Representatives: Cleveland, Dallas, Chicago, St. Louis, Detroit, Los Angeles, Washington, D. C., Leonhardt, Montreal, Toronto, Ottawa.

Photo courtesy King & Co. Inc. Ltd.
Copyright 1945 Celanece-Celluloid Corporation

A DIVISION OF CELANESE CORPORATION OF AMERICA

*The demands of wartime
aviation insure better
peacetime performance*

McQUAY-NORRIS ALTIMIZED PISTON RINGS

PISTONS..PINS.. HARDENED & GROUND PARTS

War demands new and higher standards of performance and stamina in aviation parts. McQuay-Norris with a third of a century experience in making automotive precision parts is now extending its services to the aviation industry in increasing measure. McQuay-Norris' policy of clinical research is carried out by our Aircraft Division which offers the industry various precision parts, technical assistance and research experience. Your inquiries are invited.

PRECISION WORKERS IN IRON, STEEL, ALUMINUM, BRONZE, MAGNESIUM



McQUAY-NORRIS MFG. CO. (AIRCRAFT DIVISION), ST. LOUIS, U.S.A.
CANADIAN PLANT, TORONTO, ONTARIO

**PARTS FOR
AIRCRAFT ENGINES**
Piston Rings
Oil Sealing Rings
Supercharger Rings
Compressor Parts
Machined Aluminum Pistons
Piston Pins
Counterweight Check Pins
Machined Magnesium Parts
Cylinder Hold Down Nuts
Hardened and Ground Parts

**PARTS FOR
PROPELLER ASSEMBLY**
Machined Magnesium Parts
Piston Rings

**EQUIPMENT FOR
MAINTENANCE OF AIRCRAFT**
Pistons for Oxygen
Compressor
Piston Rings for Oxygen
Compressor
Pins for Oxygen Compressor
Pistons for Air Compressor
Pins for Air Compressor
Piston Rings for Air
Compressor

LANDING GEAR PARTS
Machined Aluminum Pistons
Piston Rings
Hardened and Ground Parts



HELPING HANDS ARE FIGHTING HANDS!

Trigger fingers of fighting men depend on the willing, efficient production fingers of America's industry. That is why America's industry at its best means talent and hard work as well as plants and tools. Men and

women of Solar believe in that definition. They are setting an example of industrious production for Victory making useful numbers of "anti-monoxide" exhaust manifolds for our fighting planes.



EXHAUST SYSTEMS

SOLAR AIRCRAFT COMPANY • SAN DIEGO, CALIFORNIA

THE TOUCH OF TOMORROW IN THE PLANES OF TODAY



The New Fairchild Cargo Plane Will Speed Delivery of Tanks, Guns, Troops and Supplies

On that fateful December 7th, Washington opened the dossier marked "Blueprint for a Global War."

"Here's your kind of a job, Fairchild—to develop a plane that can help supply an army on the other side of the world."

Fairchild has that job because of 25 years of aeronautical research and engineering experience in "Creating the Plane for the Purpose." Among those planes is a notable line of cargo-carrying aircraft.

Today, Fairchild is building a new cargo plane designed expressly for carrying tanks, guns, troops and equipment over great distances for delivery to *small fields* at the front! Its precise performance and other characteristics are military secrets.

"ON THE BEAM"

"The independence and ability to go anywhere under the most adverse conditions are the most important features of our new cargo planes."

—Gen. W. H. S. Wainwright, U.S. Army

Way 4, S. Wainwright and Manager

It was created out of the needs of this war to fulfill the needs of this war. It bears the Fairchild "Touch of Tomorrow."

Other Fairchild "weapons" for winning the war include the famous Cornell primary trainers (PT-19, and PT-25) and the new Fairchild-Dorland twin-engine advanced trainer (AT-22), all powered by Ranger Aircraft Engines. And while the new Fairchild military cargo plane is the latest of these "weapons," it is by no means the last.

Fairchild Aircraft

Divisions of Fairchild Engine & Airplane Corporation, El Segundo, 384

Deep Drawn Bomber Parts are Turned out Quickly at the FORD Willow Run Plant on

HPM

FASTRVERSE PRESSES

with New 6 Point Variable Pressure Blankholder Ring

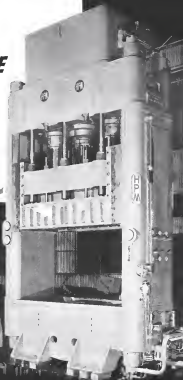
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WE ANNOUNCE "FLYING HORSEPOWER"

New — in addition to the Famous Houdry Catalytic Cracking Process — Socony-Vacuum Announces a 2nd and 3rd Revolutionary Advance in Petroleum Chemistry. Soon — for America's Fighting Planes — Amazing New Gasolines will permit much Higher Power Output from Aircraft Engines — Heavier Bomb Loads or Wider Cruising Range — Greater Yield of Aviation Base Stock.



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YARDSTICK CANNOT MEASURE
THE FULL POWER OF THESE
GREAT NEW SUPER-FUELS!**

1 After bringing Eugene Houdry to this country, Socony-Vacuum purchased with him the development of the Houdry catalytic cracking process. We were the first company to produce 100-Octane gasoline in commercial quantities by catalytic methods. From the beginning has stemmed most catalytic refining, the only method by which 100-Octane aviation gasoline can be produced in the vast quantities needed by the United States' air forces. Socony-Vacuum has produced up to now rare catalytic cracked base stock for 100-Octane gasoline than any other company.

2 Today, the T. C. C. Process (Theodore Catalytic Cracking), Socony-Vacuum's second great contribution to the refining of vital aviation fuels, is being installed in 20 American refining units (7 of them ours). The T. C. C.

Process permits continuous catalytic refining, improves the quality and increases the quantity of 100-Octane base stocks. It requires less critical materials—steel and alloys—than any other catalytic process.

3 Close on the heels of the T. C. C. Process comes Socony-Vacuum's third revolutionary scientific discovery, the Synthetic Lead Catalyst, described in the picture here. For many years, 100-Octane (which means without knock) has been the standard of gasoline performance. 100-Octane has been a straggler for profit. Now, Socony-Vacuum's Synthetic Lead Catalyst makes possible the production, in commercial quantities, of a new and better gasoline — much more powerful than any present 100-Octane gasoline — so powerful it can be greatly diluted for use as an ingredient in 100-Octane gasoline. Even then diluted, this remarkable fuel will give to aircraft a new, quick, maneuverability, speed, climbing power, and cruising capacity.

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Beechcrafts at work



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With the advent of war, most of the civilian-owned Beechcraft biplanes of recent manufacture were taken over by the Government Services and the entire new production of the factory went directly to the Army and Navy. These Beechcrafts now serve in the aerial workhorses of our Air Forces, not only at home but also behind our far-flung battle fronts. Their high cruising speed, of up to 260 miles per hour, plus their ability to land at low speed in small, unpaved fields, makes them a practical and useful vehicle for everyday use. Their ruggedness of construction reduces the necessity for spare parts to a minimum; and their economy of fuel consumption is valuable where fuel is hard to get.

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Beech Aircraft

CORPORATION

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and at a Saving of
35% in time!



View of a Sunnen Precision Honing Machine in company with standard work—ready to go into use.



Standard Honing Machine

Standard Honing Machine

Standard Honing Machine

Standard Honing Machine

Standard Honing Machine

Standard Honing Machine

Standard Honing Machine

Standard Honing Machine

Standard Honing Machine

Standard Honing Machine

Standard Honing Machine



The standard Dodge Honing Machine is the Sunnen plant—provides a finish on pistons, valves, and other parts.

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"BENDIX" LANDING GEAR

Setting a plane down on the lurching, pitching deck of an aircraft carrier on a choppy sea puts a terrific strain on vertical struts and wheels.

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BENDIX PRODUCTS DIVISION
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South Bend, Indiana



"BENDIX" LANDING GEAR

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★ ★ ★

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More than the most effective of military weapons, more than a new method of public and private transportation, aviation is a force that is reshaping our way of life. The swift and continuing expansion of aviation has created far broader needs for that basic ingredient of industry progress—information.

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• There is an equally urgent need for a publication devoted wholly and exclusively to the interests and development of our air transport industry. Air transport has joined the railroad and shipping industries as one of the great public carriers of passengers, freight, mail and express. There is a clear recognition among the thinking

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Electrical Equipment—Weapons and Tools

From miniature motors to mammoth generators, from tiny detector tubes to great broadcasting stations—everything electrical is essential to our war effort

AS this editorial goes to press, newspapers and radio news commentators are talking the domestic story of the blighting of two nearby States power dams. They are discussing down the Rocky Valley, Germany's most vital wartime production center. But vast networks of industrial activity lie inert, for the great quantities that had fed power to hundreds of plants producing war goods for Hitler, today stand idle. This during and well go down in history as one of the most, if not the most devastating of the entire war. It has destroyed two great sources of power, stopping the wheels in hundreds of plants and throwing into darkness thousands of factories and homes.

This epoch-making need by the R.A.I. brings home to us the vital importance of our own power resources, those eternal generators from which flows the current that turns the wheels of our great industries, illuminates our factories and homes and runs our electric railways and subways. It makes us realize how dependent we are on electricity and how important is the part of these mean factories who produce the electrical equipment that makes possible its generation and use.

Regarding with Thomas A. Edison, the creative genius of electrical engineering was his device and more efficient ways of generating the current, better and better means of transmitting it and of applying it to do their kinds of jobs quicker and better.

The products of electrical manufacturers have become an absolutely an essential component part of every industrial, business and domestic activity that our country and our war effort could not go on without it.

In days of peace the laboratories of our electrical industry gave us, indeed, television, lighting, air conditioning, precision process-control, information, self-actuated control liquid and more other things that border on the miraculous.

Today these facilities and their products are devoted to an almost war of wits with Axis machines and products men.

Electricity plays a significant part in this war. It is the "redoubtable" that brings support to land-powered weapons, to the mechanical motion on the battlefields. While many electrical developments today are devoted to accuracy, the action will undoubtedly require these electrical mechanisms when the action is hot.

The fire-fighting experience of electrical instruments, apparatus and machines becomes evident when we realize that over 150 different electrical items go into our hot coils and that more than 170 go into a lighter plane. Most of these products are directly subject to action and are far removed from their civilian counterparts. If, indeed, they have any counterparts.

To the contrary, a light bulb is something so standardized that every need can be filled by any market dealer. Our steel lances, by contrast, must have at their disposal

more than 400 different types of lamps. Some are larger than the head of a nail, are so brilliant that they flash signals under a tropical noon-day. Others are built to withstand extremely low temperatures, vibration, shock and many other things to which they are subjected.

On planes, for example, non-renewal incandescent filament motors are used but the standard industrial motor is not suitable for this service. New records in low weight per horsepower had to be achieved involving extensive changes in design and production.

To prevent the light from instrument panels from impairing the vision of night fighters, ultra-violet radiation which activates fluorescent instrument dials was developed. As a result, the pilot not look out into the darkness but rather his instruments, without the least effect on his eyes. How many precious lives in victory can be credited to this one development alone?

But, in general, the story of this industry's war work is really too blurred by statistics, according to afford an adequate picture of its contributions. The factories and shipyards that are turning out our military toll is more complete story. Many of these have been built during the past two years. Others have gone through a complete conversion process. In every case, huge quantities of electrical materials were involved.

In the broader picture, three major jobs which the industry has had to do, in addition to equipping our modern war machine. It has had to supply materials for the vast expansion of our industrial system, keep every plant fully maintained, and provide the necessary equipment for the vital power and communication fields.

More than \$3,500,000,000 was spent for non-industrial construction in 1942, and of this about 7% or \$140,000,000 was for electrical materials. Non-machine tools and other production equipment required an additional \$170,000,000 worth of electrical products. This enormous program called for another \$145,000,000 of electrical apparatus and supplies.

The total of over \$600,000,000 in itself would have staggered the electrical industry in a peacetime year. Yet, this record breaking production was essential and had to be superimposed upon the direct requirements of the Army and Navy.

Industry depends upon electricity. Consider for a moment the effect of modern lighting upon our production facilities. Imagine how much of illumination and light quality that was unknown of ten years ago. As a result, midnight shifts operate at daytime efficiency. As a matter of fact, many of the most modern plants have no windows at all.

Then there is communication. The failure of one single wire or feeder will stop a production line. Electrical communications have had to stand at all times ready to

supply the heavy demand for the maintenance and repair parts that keep our industrial machine operating at top speed. Extra hours, 24-hour schedules and unimpeded production limits combine to shorten the lives of electrical equipment.

Electrical manufacturers have had to supply the greatly expanded needs of our power and communication systems. New construction of all sorts — sea, plane, continents, war housing — has created a formidable need for additional capacity. Every electrical or non-electrical concern has called for increased communication and power service. All this had to be superimposed upon the vast demands of our armed forces. The magnitude of this task is obvious but it is being successfully accomplished. There

Other electronic devices, in assembling and testing the products of thousands of new plants. Processors coordinate all sorts of processes, from aluminum production to atomic pile assembling.

There are but a few of many examples of the way in which the huge power of electricity has been harnessed to the war effort. Back of every development there is at least one electrical manufacturer — more often many — who have pooled ideas and facilities with no thought of rivalry or dispute over cost allocation.

No story of the electrical industry would be complete that did not pay tribute to those manufacturers who have dropped their normal bias in order to produce special war products. Many appliance manufacturers fall in this group. When war came, they did not stop to argue that their normal trade and big products would demand a con-

This is the twelfth of a series of editorials appearing monthly in all McGraw-Hill publications, reaching more than one and one-half million readers, and is daily newspapers in New York, Chicago and Washington, D. C. They are dedicated to the purpose of telling the part that each industry is playing in the war effort and of informing the public on the magnificent war production accomplishments of America's industries.

tinued supply of their products. They have been so busy in their power or in their communication. Part of the credit for this performance belongs to the thousands of manufacturers who delivered their products when and where they were needed.

This was not merely a problem of increasing production. These manufacturers had been depending on rubber, copper, aluminum and steel — all highly critical materials. For much of this war industry production they suddenly had either to find substitutes or practice the strict economy, and in quantity.

Solutions to many problems were quickly found. Light war manufacturers greatly reduced their use of steel by designing efficiently, and saving materials. War steel cable manufacturers expanded their use of synthetic materials in place of rubber and this generated the use of higher distribution voltages so that every ounce of copper would work twice as effectively.

Steel is essential in apparatus that operates magnetically. There is no known substitute. But marked economies in its use have been achieved through the development of new alloys that are of increased magnetic efficiency. As a result, motors and transformers are compact, substantially less than they did once of equal capacity a year or two ago.

Electrical manufacturers have given our industries an immense war production boost. Industrial heating furnaces, for example, have drastically reduced the time involved in production drying — in some cases from hours to minutes. High frequency induction heating has been spectacularly successful in the forging, bending, hardening and coating of resistance. Modern welding equipment often possible speedy production with unimpeded labor.

Aircraft's production lines are being protected by electronic devices which eliminate human error. One million volt X-ray equipment holes through castings and points out underlying layer defects. An electronic flow detector tests nonferrous alloys metal tubing for imperfections.

000,000 in 1942. It has done this with all the cost of war, for the U. S. is young and a powerful industry. Low economies in this industry are felt everywhere, all the industry are much younger. Top management in general is young, too, and many outstanding technical developments have come from the brains of men just a few years out of college.

The scale of all this advance intelligent work can be found in every factory on every battlefield and near, and even in the laboratories of our Navy. In a sense, the electrical manufacturing industry stands beside every soldier and every sailor as he goes into action. It has a place of honor in every defense.

And when the war passes into history, as it must, will not mankind and posterity owe to posterity the fact that a life greatly enriched by electrical developments that were achieved of yesterday.

John H. McPhee, Jr.

President, McGraw-Hill Publishing Company, Inc.

Let's Be Realists About the Future

POSTWAR REALISTS that face us can be made about as complex or as simple as you wish. If you want to be wholly practical about them you begin by leaving aside such vague generalizations as "frustration of the war." At the most time you had better get rid of that one that says "satiation is dead."

If you are willing to foresee a postwar world with national boundaries, age-old hatreds, and divisions of convenience, you can visualize an arrangement under which each nation will operate its own airlines while the lines between them will be under the jurisdiction of those governments who do the most wide law trading. It therefore behooves our political leaders to seek the advice of aviation men who know the technical possibilities and limitations of the airplane. By so doing, and leaders will, at the same time, increase the stature of their statesmanship.

BEFORE the agency of the airplane the control of the seas was maintained by the countries with the biggest navies. The control of the air will be maintained likewise by the countries with the biggest air forces. Air power, by definition, consists of planes, men, and bases. As the usage of aircraft increases, the control of protecting basis for each nation will extend farther and farther from the national boundaries and the included zones will seriously overlap. No nation can expect to plant military establishments on another's doorstep without granting reciprocal privileges to the other.

And that's how we started. The desecrating factors in preserving peace will be the fundamental agreements and trade relations between nations plus a healthy dash of airpower.

Many of these problems in international relations are beyond the scope of the aviation industry. But upon their solution depends the question of whether America will, or will not, have a vital aviation industry. In the period decade it was the export market that kept our manufacturing industry alive. But this export demand was created by a world preparing for war. Unless a satisfactory substitute for this emergency need is found, the whole future of the manufacturing industry will be threatened. No artificial stimulus will suffice for long.

Until there is a definite air policy for this nation, coordinated with those of the other United Nations, neither our manufacturing nor our aviation industries can move forward toward specific objectives. But there are a few things that can be done by the industries immediately.

Let's start by being realistic about domestic transport expansion. If we carried all the first class mail and a substantial share of the first class passengers by air it would not require as many additional planes as some wishful thinkers believe. Certainly this equipment would absorb only an infinitesimal percentage of existing productive capacity.

The most fertile field for use of additional airplanes would be air freight. But it is a long way from 50¢ to 15¢ per ton-mile. The reduction of operating cost is therefore a primary problem for designers and operators alike. No countries where ground transportation is not as highly developed as it is here, this factor is less important, but if we are to have one full share of the commercial export market, we must continue to manufacture the best and most efficient planes in the world.

For our purposes air resources are sound, there will be a substantial increase in the need for very large aircraft required for international service. At the other extreme is use of the small feeder line ship, and here the field should be fertile in number of units produced.

But all of this added together will not equal in value the equipment required for preservation of our national security and for keeping habitual aggressors under control. The public demand for postwar peacetime is high at the moment and will continue to be for some little time. Now is the time for our aviators to lay firm foundations for our future security. If they await our return to peace and idleness, it may be too late.

Leslie E. Zwick

EDITOR



With the Nazis completely thrown out of Africa, America's warplanes are given grounds hard to tell the Axis out of the North Pacific.

Associated Press



AVIATION'S
WAR COMMUNIQUE
NO. 35

Smoking victory of Sicily saw our forces
outbid the highly trained Luftwaffe. Here,
Boring Flying Fortress have full charge and

warrior planes burning in dropped area ad-
joining El Arona Airport. Paratroops in upper
left.

AP Wire Photo

America at War

Allied air power plays important role in fuel African push
as battle records are set . . . Pressure increases for more planes to blast Japs,
but Allied strategy targets Hitler as No. 1 . . . Production realists estimate this year's output
at 85,000 to 90,000 planes rather than oft-quoted 100,000-plus.

AMERICAN'S war machine now becomes an Allied lake as the Axis—Luftwaffe and all—gets pushed out of Africa. And allied air power played its rightful role, blinding paths for the magnificent American, British, and French ground forces as their final rushes to Berber and Tunis. New records for the number of sorties—single missions of single planes—were set as Tunisians alone became as Allied-dominated as the rest of the hills and plains south of the Mediterranean. More than 2,500 sorties were chalked up by the Allied Air Forces on the same day.

The dive bomber fades from the news and Gen. Ira Eaker, commanding the Eighth Air Force, says it is an "apparent" weapon which was most hard for redeployed targets. The British reach complete agree-



ment with the United States on the wisdom and effectiveness of day bombing. The Luftwaffe continues to perch back land, but its warning power becomes more obvious as it fails to retaliate against England or to properly aid Germany's hard-pressed forces in the East. In the Orient, both MacArthur and Chiang Kai-shek plead for airplanes to at least match the overcast at Japanese, but the Allied high command stands firm on its demand that Hitler must be knocked off first.

A sentence buried in a recent article by Joseph Goebbels' fresh propagandist, speaks more eloquently than could any outside estimate of damage done to Germany by Allied air attack. Goebbels, trying to cheer the war-weary people of Germany as paradise (Turn to page 37).



One of the two control dams built entirely via air transport, the other being completely assembled for delivery at the needed spot by air means. The other another point on the Foulmouth River control water output for a 1,600,000-hp plant, which now produces a large portion of the electricity going into Allied fighting planes.

Air Freight, Unlimited

By DAVID BAKER, Assistant Editor, "Aviation"

First detailed story on one of the biggest, toughest all-air freight jobs ever completed. Throwing new light on the importance of medium-sized planes in year-round sub-arctic operations.

CLARE YOU BEHOLD a dam by air! The answer is definitely yes, for in Canada they've built out one big two-large control dams supplying power for a greatly enlarged plant to make aluminum for more Allied warplanes.

The story—outlined here in detail for the first time following lifting of the

seasonal—made a brilliant new chapter for air transport, because the job was one of the largest and toughest air freight ventures ever completed. It is a chapter crowded with lessons of value both in current and postwar air transport, for here was a case where various agencies didn't choose an easier out the window.

The job was the Shipshaw water-power project for the Aluminum Co. of Canada, and it meant flying more than 8,000,000 lb. of construction equipment, supplies, men, and even some live animals. Three 4,000 tons was moved between Aug. 1940 and Oct. 1941 by but one airplane—most of them old

Operating from this base on Lake Oatishaw, past supplies carried out through equipment to build two dams, between a total of 4,000 tons in the period Aug. 1938 to Oct. 1941.

vehicles—of Canadian Airways, now a part of Canadian Pacific Air Lines' far reaching network.

As it has likewise done, without the fuel, for so many remote routes, other was inaccessible oil fields, and timber land surveys, the Aerial Services Div. of Canadian Pacific had the ground work by mapping the vast watershed north of the Saginaw River south and Lake St. John. On the basis of the aerial survey, two chains and control dams were prepared one on Lake Muskrat (lying 125 mi. north of the central power site on the Saginaw), the other at Peace River south of the Peace River, some distance below Lake Fortin.

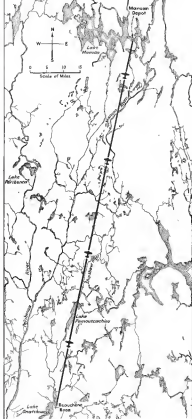
It meant auxiliary—heavy machinery and lots of it. And in a territory virtually without roads there was but one answer: Air freight.

When the job was started, there was a road of sorts running part way to Lake Oatishaw, which was to be the base of the northern terminal flight base. This road was extended to Lake Oatishaw's lowest finger, and during open water season, supplies were moved from road's end by barges to the flight base at Birchburn, 15 mi. up the east side of the lake.

Here, in Aug. 1941, was hurriedly assembled a "fleet" of six sturdy two-year old planes: Two Fairchild 82's, two Fairchild 71's, a Bellanca Passmaster, and soon after, a single-engine Cessna 440-32. To feed the fleet, two 1,600-gal. gasoline tanks were brought in and placed underground. From there on, all gasoline was brought in 45-gal drums by road and barge before winter set in. A Johnson Gasoline electric system was installed, with the tanks manifolded together into a pipeline and two electric pumps set up beside the shore to speed refueling operations. Muskrat's, shacks and tents were erected to complete the base.

The first contract was a tough one, calling for delivery of some 700 tons at Lake Muskrat before the freeze in early October—just about two months away. The teams from Banafish to Muskrat by road, by rail, by air, along the Shipshaw and Muskrat Rivers and lake chain, and providing roads—no might be expected—also from the north and northwest. In addition in several backwaters, the "ice" trips were all uphill, for the terrain to be covered ran from 400 ft. above sea level at Birchburn to some 1,500 ft. at Muskrat, with rough, hilly country and lakes between. (The accompanying map shows the region and the route.)

Lately because of the nature of the terrain, all lines were carefully laid, and the pilots had to know every bend and wide place in the river in that in case of engine trouble or low visibility



(the latter a frequent occurrence) they would know just where to "set it down" safely. To avoid collision in "diving" weather, pilots were restricted to follow the east side of the main runway at the Shipshaw, coming north they flew west toward the Perchance. In good weather, average flying altitude was 3,000 ft.

Cargo to be moved included everything from a diesel shovel, bulldozers, a saw mill, tractors, cranes, dynamite, gasoline and fuel oil, to rations, a 1,000-lb. motor boat, two horses, four cars, and a new to supply fresh milk. The cow later went dry and became strays and stars.

Some of the machinery came, although was damaged, from old law books to go through areas the whole shore of the Ju-52. But here the experience learned from experience gained at a similar operation in Hong Kong meant machinery in Hudson, New Jersey, for which the Ju-52 had been especially prepared. The largest pieces, such as the shovel arm, tail rotor and tractor frames, were simply cut by acetylene torch into sections that could be made to fit, then loaded and flown in the job, where they were welded together again. To facilitate this type of work, a scale model of the Ju-52's fuselage was kept in the main office at Montreal. In case of very close measurements, scale models of the parts to be loaded were "tried" with the model to make sure they would fit.

This bushy surprise is of particular interest, for although it was acquired by Canadian Airways back in 1935, its owners refused to even deliver as one of the most outstanding single-engine craft for the specific job of work involved in the Shipshaw job. It may also be of interest to know that the Ju-52 could be bought at that time in three versions of one, two, and three engines. The single-engine type was offered as an economical freight train port and had a public demonstration at the Berlin-Tegel airport on Feb. 17, 1931. The Ju-52, equipped with the same three-engine type, is a development of the Ju-52, which originally



This German Airplane, which proved the first in the fall of 1940, landed loads of 3,000 lb. The other planes (except for the Ju-52) carried fairly standard loads of about 1,700 lb., a single common denominator saving loading time by enabling men to prepare in advance several uniform lots which could be moved in whatever plane arrived first.



The Ju-52, powered by a Rolls-Royce Perseus, weighs a 14-ft. propeller which is a replica of the original. This craft was available with one, two, or three engines. Fuel tanks propeller were used to some extent by leaders in the early 30's, one interesting application being on the Ju-52, which had two blade engines on the tail and engines, two blades on the outboard. Note skids wing tips, used also in the Ju-52. Cargo and spare wings were flown as belly loads.



On this the Ju-52 could carry 5,500 lb. Snow was kept hand-pumped on the ice, and runways were marked out by emergency ho poles. Twelve miles of ice were required under this plane.

Since installation included two electric gas pumps and a narrow gauge railway. Several dubs accompanied the various planes, which were loaded so that they never pumps were needed to keep going.

mounted a BMW-TA, Vno-type 32 cyl. liquid-cooled 675-hp. engine, weighing a 35 ft. four-bladed propeller of magnesium metal.

On the Shipshaw contract, however, it was powered by a Rolls-Royce Perseus of 875 hp. It carried a new American (London) propeller of a little over 14-ft. but otherwise almost identical with the original. The BMW loaded up about 1,000 rpm, with a 24. reduction gear, the Rolls-Royce turned over about 3,300 rpm, and has a slightly less than 2:1 reduction, giving over 3,200 rpm on the propeller. With the power plant the plane regularly carried loads of 3,000 lb.

Operating mildly on fields, the six planes carried well over the required 700 tons of assorted freight up to Lake Meade before the freeze. By getting on Aug. 7, 19 loads were flown from the airport at Hoberg, on Lake St. John, before planes were based on Sherbrook following completion of the road on Aug. 19.

By October, however, it was apparent that the job would last some time. The original contract was enlarged, and preparations were made for a year's operation. Permanent skids were built to replace the ice. Skids were loaded as overhead by road to last through the water, for the road was made possible in heavy snow. A supply of 43,000 gal. of gas was laid in and storage tanks filled; one with 17 sections, the other with 50 sections, while reserve supplies were stored in small drums in a warehouse built for the purpose.

After a six-week interval during home-up, operations were resumed early in December on the Five more planes were added to the fleet. Another Fairchild 82, two more Fairchild 71's, a Nordberg Versmoor, and a Bellanca J-300. The two original Fairchild 82's had been borrowed from Sherbrook Airways and were now returned, leaving only one 82 on the job. Total new planes—Ju 52, Airbus, Versmoor, Perseus, four 71's, one 82.

The Fairchild 71's were powered by Pratt & Whitney R-1175 of 450 hp, the Perseus by a Wright J-6 8-cyl. engine of 330 hp, the Airbus by a Wright J-32 engine of 750 hp, and the Ju-52 by the Rolls-Royce Perseus, previously mentioned. All except the Airbus burned 58 sections fuel, the engine required 57 sections.

At the stage the flying personnel consisted of 15 pilots, headed by Superintendent of Operations Harold C. Smith, who also flew to relieve the others. There were two maintenance



A familiar sight over Germany, the six Ju-52s were used to carry the bulk of the cargo to the airfield. The Ju-52 was used to carry the bulk of the cargo to the airfield.

men for each plane, one air engineer and one licensed mechanic. Herb Lovell was engineer in charge at Sherbrook, and Jimmy Kirk was engineer in charge of the Ju-52, affectionately called "the King of the Ice."



With engine change and 30 and 180 lb. skids were accomplished in wood-based snow-laden areas 10-15 hours. Skidding was aided by skids and guides of different sizes to the engine.



Each engine was pulled after 415 engine hours, replaced by a spare, and flown to Winnipeg or Montreal for complete overhaul. Each plane flew an average of 180 hr. per month, and the whole lot as much as 190 hr. Several had for one day were 20 hours per plane in 24 hours—five days for the Fairchild 82, four for the others—and several other days 24, 25, and 26 hours were skidded up. Spare parts stored for emergency.

In engine overhaul, 36 and 180-hr. checks were performed during the winter in excess more hours loaded by a spare engine were changed after 400 or 450 engine hours, an operation time, which, with long periods needed for warm up, was worked around the same amount of flying time. One spare engine for each plane was kept in readiness in order to maintain schedule. When an engine's time was up, it was pulled, replaced by the winging unit, and flown to Montreal or Winnipeg for complete overhaul. Each plane flew an average of 180 hr. per month, and the whole lot as much as 190 hr. Several had for one day were 20 hours per plane in 24 hours—five days for the Fairchild 82, four for the others—and several other days 24, 25, and 26 hours were skidded up. Spare parts stored for emergency.

(Turn to page 335)



Fighters and Bombers Fly Home for Repair

By JOHN FOSTER, JR.,
Associate Editor, Aviation

First complete thery are Air Service Command's system for fourth echelon maintenance which gets combat planes back in action with maximum speed and safety.

FLEWING EASTWARD and homeward in thousands of miles from England, Africa, Alaska, or the South Pacific to the middle of the United States for repair is neither a dream nor a stout, it's the usual thing today—part of the Air Service Command's operation of the world wide "Keep 'Em Flying" program.

It is not only safer, but faster, to overhaul combat craft far from possible bombing areas, and ABC has eleven major control depots to do the job. A typical depot is that of the Oklahoma City Air Depot, where heavy and medium bombers, attack planes, fighters—any training and liaison planes—may be sent to be repaired. As for the combat areas, the planes, when they are ready to go into battle, for every craft is complete down to the smallest item of equipment.

In its role as a supply depot, OCAID's stock includes every one of the 154,000

air items which our AAF requires. Furthermore, it is a hot a matter of hours to get to any theater of war. Consider



First step of fourth echelon overhaul, after plane has been flown back from front, is complete stream bath. Then it goes into "production line" overhaul set up to get complete processing in record time.

Combat crews pick up Consolidated B-24 Liberator bombers at Air Service Command's Oklahoma City Air Depot. Both crews and craft are ready for combat and are sent a series of tests from any theater of war. New Douglas C-54 cargo plane is built ground, testing in landing deck to take on cargo of "hot freight" is in order in flying hours.

how new under way will make it more than a geographic center of operations for the Air Transport Command, which already then newly needed parts all over the world on regular schedule.

The Oklahoma City Air Depot was built two years ago and now has 15,000,000 dollars already in it. It is a multi-million dollar project covering 2,000 acres with a total "population" of some 15,000 crafts and Army personnel—and it is still growing. It is one of the largest under production of Maj. Gen. Walter H. Frank, ABC's Commanding General.

Despite this enormous growth, the entire operation operates under one philosophy: "Let's get the stuff where it's needed." The overhauled rule was established by Col. William Turnbull, OCAID's first commanding officer, and it is being continued by the new chief, Peter Gen. Andrew W. Vanaman, former commanding officer of Wright Field.

The exact number of planes OCAID has put back on active duty cannot be revealed, but as indication of the number can be gained by following through the works a typical plane. A Boeing B-29 Superfortress called the AT-100, K-1, lately back from England.

As the plane enters one of the repair bays it first gets a complete stream bath to remove the layers of battle-dust

and grime, and, or perhaps desert sand. Then it takes its place on the "production line" where it is literally tapped to pieces by men and women from the engine, electric, hydraulic, instrument, and other sections.

The overhaul repair group does all its work on the line, inspecting and repairing everything necessary, as well as checking and overhauling all systems. Many of the planes are, of course, packed with bullet holes, but it has been found that the field patches put on by maintenance crews at the front are entirely satisfactory—it's only the large cracks in anti-aircraft shell holes in vital spots that require replacing at OCAID.

But the depot doesn't stop with major overhaul, it also sees to it an entire modification under intelligence and. When combat crews bring their planes in, they are questioned by men from the flight test, engineering, armor, and other sections, such as intelligence staff men at the front, but then they are sent on to anti-aircraft shell holes in vital spots that require replacing at OCAID.

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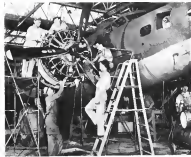
It, as a shop goes on the line, it is found that a wing has been severely damaged, all it takes to go to the wing section where it is equipped to do every thing up to a complete rebuilding job on anything from a "grasshopper" liaison plane to a four-engine bomber. For some types of planes there are permanent jigs, built at the depot from factory Air plans, for others there are portable jigs adaptable to take a variety of types and sizes.

This section also handles the rebuilding of fuel tanks and provides one of the first examples of the "let's get it done" spirit pervading all Air Service Command installations. All tanks must be fuelled and tested, then dried before

Engines are dismounted and sent to repair section for complete test down, repair, inspection, and immediately in start in latest degree of mass production at home, more it must first run one, two, or four engines per plane. On each job 10,000 to 15,000 hours have entered flying hours engines in 30 min. day.



Overhaul repair section employs production line technique, with Boeing B-29 bomber technicians have engineering through sections from stream bath area in right wing. To speed operations work lines, with necessary parts for each station, are located in area at plant's left.





Here, engines mounted on wheels roll down one of two free-flow lanes, with repair handling speeds operators. Parts are all numbered and placed in wire trays seen at left, for trip through crane, solvent, or soap and water cleaning. Back to right has painted identification for each tool so that none can be misplaced or lost.



Following cleaning, repair, and inspection of parts, engines are assembled on production line. In hangar, moving past overhead cranes in stations. In less than four months, more than 1,000 engines were overhauled. They ranged from 65 hp primary trainer power plants to high-powered liquid and aerobically tapered and bomber engines.



All right and engine instruments are in second-line plant and repaired in separate accommodations quarters. Each employee follows job from disassembly through repair and testing. All employees—mostly men, and women from local community—are qualified on at least one group of instruments; many can handle any instrument on any plane. Here, master test instrument is being type equipment.

being fitted with controls. Several members of the service at OK MA, among spare parts, had a kitchen, which stores the tools in but one RMA the time directly required. All such facilities, of course, because the property of the Air Force, but it doesn't stop the employees from looking more.

Meanwhile, members of the service

service have been working out. In side with language experiences, maintaining, operating, and recording references. To some, too, everything which can be repaired in the plane is being right in the line, but when necessary the parts are measured and sent to the service's quarters in another building where repair and test equipment is available.



Civilian employees—many of them women—at Oklahoma City Air Depot regularly receive gross from planes, repair, and no detail from within it. Arrangements are made here in one of largest organizations of its kind in country.



Typical of liquidity system all over here is the hydraulic crane for hoisting 500 MB to mean this state of heavy bomber landing gear, which are at two feet with great safety and more speed than any of the new did formerly. Covered and built in depot shops, the crane is capable of 10,000, 15,000, 20,000, and 30,000.



Oklahoma City Air Depot's activities (such include inspection of cranes and slings) for various flight crews. "Dead Grade" commensurate capability of depot's steel mill which made all toolings.

Rollers are handled by another section. All are one material from the plane and sent to the service's own quarters in another, or conditioned and repaired with long-stay equipment. Here, in most of sections, one operator handles job of the day, though this holds true for all who control these which must be finished on working shifts, for OCAI operates 24 hr. a day, 7 days a week.

With the plane still in the test station, the loading system has gone to work to get the "breakdown" system in



Kind DEAD service is rendered by roller pool, which regularly moves more than 1,000,000 lb. of AAF material per month in nine months. New equipment is being acquired, but more can be obtained, the most pool has already delivered supplies to both units. As with other sections, Army officers lead section, assisted by civilian engineers.

part of section. Here, again, in evidence of Air Service Command capacity, is completed by a job—initially, at center—for loading into position, the 300,000 lb. main deck of the heavy bomber. By its use, one in two men do with great safety and more speed an operation formerly taking four and four men. Still right in the OK MA section itself, the job is adjusted, for use in (Text to page 104)



Air Service Command's eleven control depots are really big hangars, largest AAF plants in air throughout world. Oklahoma City Depot stock contains over 10,000 separate items and is used by AAF—covering everything from spare parts, to complete aircraft wings. Plans show any portion of shipping department depending perhaps at all times and shapes by air, rail, or truck.



Plans and training section is training several thousand students who are sent from 20 to over 50—on recall the fleet, planes to take care of rapid expansion of base. In addition, several thousand trained men are being given special training for engine and air craft maintenance jobs at home and abroad. Production of units in treatment class, thus, has a clear evidence that base's power 35 percent because employees will now up 60 percent.

Trail Blazing in the Skies

1931



REFINEMENTS IN THE TECHNIQUE OF SPOTWELDING STRUCTURAL ALUMINUM ALLOYS

were patented by Goodyear Aircraft Corporation in 1931, and used in the construction of the airships Akron and Macon — the largest aircraft structures ever built of aluminum alloy in this country. The economy, speed and durability of this process have since led to its widespread use throughout the aircraft industry.

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By E. A. VON HAKE

Forrest, Jr., Chicago Manufacturing,
Lockheed Aircraft Corp.

Here is a step-by-step description of methods employed at Lockheed to produce a 165-gal streamlined steel drop tank every four and one-half minutes at about one-seventh the cost of aluminum tanks formerly produced.

IN ORDER to increase the useful flight range of the Lockheed P-38 Lightning for long distance missions, it was necessary to increase the fuel-carrying capacity without appreciably decreasing the aerodynamic efficiency. Thus, a fuel container was needed that could be disposed with when it ceased to have utility as a storage tank.

This project, which had been presented to Lockheed at the specific request of the Army Air Force, initiated an experimental program for designing a low-cost production aluminum tank to increase functional performance. The steel barrel tanks and light tanks proved consistently the feasibility of such a dropable tank, and Lockheed was given a medium sized contract based on the experimental design.

This aluminum alloy tank incorporated a semi-monocoque structure of circular cross section and tapered flow contour. Since two tanks were to be hung under the wings, one in each bay between the fuselage and aileron, it was possible to utilize the standard bomb structure that were designed for P-38 center sections. The tank frame which coated with these supports were magnesium bronze castings, and were designed to clear the two halves of the main supporting bulkheads. The original design called for eight bulkheads to increase fuel assembly operations. However, approximately 66 percent of all assembly time was spent after the two half shells were mated. This condition created because of the limited access to the main



Fig. 1 During the development period a completed tank was built and subjected to vibration tests, according to Army Navy specifications.



Fig. 2 As was in 1/4 shell steel tanks were pressed successful and assembly line was running smoothly, work was started in getting 1/4 shell construction. After the preliminary investigation on 1/4 shell dropable tank, a three-quarter size pattern was not required to form a half shell of constant shape, using an elliptical longitudinal form. The work was not possible to be a steel member of a constant section, but rather a pilot part for a test of construction of forming light-gauge steel in half-shell sections, using one operation. A characteristic of this type of forming is common of the flange die, all concerning being done by Kalkreuth using two Kalkreuth draw rings.



Fig. 3 Three-quarter size pilot part remains were very successful, standard a full size pattern and draw ring were started. Even though three-quarter size shell formed successfully, 60% only was anticipated with a full size pattern, due to "padding" incidence in large longitudinal half sections of this type. Tanks were punch form and 1/4 in. draw radius were given back punch for preliminary test run. This 1/4 in. radius was too sharp, caused material in four corners of high draw necessary to pull material from under half-draw steps. Ring used had a smooth radius for preliminary test, but draw heads were necessary for proper removal of steel in order to prevent excessive padding.

bulkhead to the rearward plane and also because of the excessive tank wall around the periphery in more practical tanks.

Tools had been designed and tanks were being delivered—first mass production requirement was more. And in addition to requiring over 200 tanks a day, the Air Force required a change to have the tanks designed in a low strategic material than aluminum alloy.

At the time of this report—the summer of 1942—Lockheed's engineering department had initiated its own critical material conversion program and was investigating the use of plastics, plywood, and semi-body steel, but with secondary structural applications to the tank job. After preliminary investigations, from cost and production standpoint, plastic and plywood were rejected in favor of semi-body steel construction. Of paramount importance in the decision of accepting steel was the lesser material economy as well as the common advantages of spot and seam welding, both of which are so readily welded in the material.

The working tank is made in "one-shot design" with all spots fabricated out of low-carbon steel and almost 100 percent of all assembly work completed before the half shells are mated. The following is a brief summary of the design applications that were worked out with the full cooperation of the factory personnel which led out the new plant set up for handling the entire tank line.

Probably the most spectacular of all

improvements on this new "one-shot design tank" was the incorporation of a single half-shell stamping line (see Fig. 4). These shells are now formed in a single operation, which is possible by utilizing the draw characteristics of ring draw body steel (43 steel) support in the area of ring of assembly time was the splitting of the main tank supports to allow complete half-shell assemblies (see Figs. 5 and 6). These flanges are now welded low carbon steel ends costing less than 50¢ per tank as compared with 53¢ for the magnesium bronze castings.

Elimination of the corners inside the tank which had led to the many leaks



Fig. 4 Half-shell dies were pre-designed without padding or excessive overlap. The saving of material was within design requirements.

Fig. 5 First operation is by drilling of flanges with counter-boring holes for securing a ring of each half shell during assembly operations. The left hand shell in which is assembled all the flanges, the right hand adapter is first part to be welded in place. This was done with a special design made for the specific operation.



Fig. 6 After installation of filler weld strips, half shell is placed on welding machine No. 3, where two half-shells and one forward wing are installed. Some machines are used for installation of fuselage and half-shells in both right and left hand units. Half-shell sections are, in turn, placed in welding machine No. 2, where remaining half-shells are collapsed welded in place. Left and right hand halves are then joined in order to secure free flow of gases in rearward flow.

Fig. 7 (Right) Vent tube is inserted in left hand half shell by gas welding in flange of half-shell. An airplane type venting



welding was used originally, but due to increasing material shortages a change was made to use non-welded, sheet-metal venting. A vent, placed in the machine forward of the half-shell was then formed in place. Tanks or tanks in need of modification, in some of the half-shells have been used as protective welding against rust or corrosion during handling process. At completion of conversion from all spot welding of both right and left hand halves are usually required in a matter of weeks and if necessary, repairs are made by flame welding at that time. Next, flange for wing, as well as fuel line, is formed in place in left hand shell.

heads also allowed elimination of the final inspection holes. Standard aircraft taking was replaced by commercial metal control, and four-piece built-up tail plugs were replaced by commercial pipe fittings. At the suggestion of fac-

tory personnel, the filler weld was replaced by manual seam welding in case operations, as seen in Fig. 5.

However, one of the most interesting production considerations initiated by the shop men was the development of

own automatic half-spot-welding machines for assembling five half-shells simultaneously (Fig. 6). With three operators, these machines are capable of putting out 600 spots per minute as compared with 15 to 30 single spots on



Fig. 8 Special spot welding equipment was designed to attach fuselage in place. Some machines are used to join attach wing flange to main frame half-shells while being held in place by power holding device. This machine breaks an overhead track and operates in production while in motion.



Fig. 9 Another designed spotwelding device is used to attach half-shells to half-shell and is designed to function in horizontal plane. This operation is also performed while conveyor line is in motion.



Fig. 10 Specialized press for spot welding equipment in tank holding unit were developed and installed in spotwelding area.



Fig. 11 Press, which consists of left and right-hand parts, is used welded in position after it has been accurately located by a cross. Location of press and drive half-shell attaching points is critical, since locks, which are assembled to a later operation, must attach with their mating part with very little tolerance.



the original task. After final testing of the two halves, the outstanding flange is now welded around the entire per-

Fig. 12 Work area of an automatic welder, half-shell holding units are mounted in production and drilled holes. A welding compound is placed under each tank to ensure accurate linkage around each half shell. Next operation consists of inspection and marking of halves. Half-shell arrangement makes it possible to perform practically all other operations before halves are welded together.

iphery, thus eliminating all touch welds, except of the tail plug and pin connections (Figs. 13 and 14).

The factory coachman who was assigned to this steel conversion job conferred with the manufacturing department in the determination of all lightweight, low-cost production features, as these conditions arose. In addition, it was deemed necessary to set up a production line in some single location to take care of all fabrication and assembly problems from the first to the last operation, including pouring and casting. Each time the available flow-up on power



Fig. 13 Half-shells are later moved by conveyor. Close fasteners through the cutting holes in flange. After flange has been installed, flange can be suspended in material. After completion of the spotwelding, flange and clamps are removed and tank is taken from conveyor stand, placed on special dolly, and flange completely refastened without body used here is specially constructed with spring arrangement so in slight pressure will hold tank at proper level while being welded.





Fig. 14 For production of raw tanks, four conveyor tracks are used, two of which are shown in this photograph. Tanks are transferred from this conveyor to another one which carries tank through final stages, consisting of slushing, flushing, drying, welding and drying, painting, inspection, and crating.

and slushing equipment were investigated, and the newly acquired plant at Merwood, Calif., offered the best possibilities for the development of this project. After this decision was reached, a satisfactory layout was developed and built around a plan for using a common conveyor system. Much of the equip-

ment that was on report, this line was secured from previous supplies, thus minimizing the need for new equipment.

This line consisted of an overhead conveyor from which 36 cradles were suspended, each cradle holding one tank. All welding and assembly equipment was located along the line in areas close



Fig. 15 Tank is then removed to conveyor line and conveyor standing area is traversed by an electric chair.



Fig. 16 After treatment and painting, tanks and all areas are welded by spot welding as shown.

with the sequence of operations. Fundamentally, the layout embodied an assembling chain and a precise shipping chain, both being from overhead monorails. These two chains were interconnected to maintain a uniform flow of tanks through the slushing booth where the transfer from one line to another was made. The operations on the assembly conveyor consist of welding and mechanical assembly, with the cleaning, painting, and final inspection on the process line.

All of the above requirements, which were incorporated in the design, and manufacturing of the new tank, resulted in a unit having a 1 to 1, plus a production time saving of 1 to 25. Both was possible only because of the close coordination and cooperation of all engineers and factory men.



Fig. 17 Two tanks are removed from conveyor line and placed diagonally on a cradle, one on either side, from each tank are pumped 20 to 30 gal of slushing compound. Cradle is then rotated for two minutes in one direction, then two minutes in opposite direction. This assures proper coating of all inside surfaces of tank and breaks down any oil film that might be left on interior of tank. A manual and hand are used to remove precisely filled tank from cradle and place it on dolly as it may be related to slushing reservoir and drained. All necessary precautions are made to remove excess liquid to comply with State Board of Health requirements. After draining, tank is subjected to blast air but no wheel dress compound and leaves protective coating on inside of tank. During development of slushing procedure, four different types of compounds were used and an attempt was made to obtain optimum conditions regarding inflammability, toxicity, coverage, and drying and impact properties.



Fig. 18 Tank remains in hot paint room, where one man of this chrome plating and one man of camouflage are applied, to accordance with AC specifications. This job can be done with but a delay between primer and lacquer coats, no primer coat being instantly upon contact with warm metal tank. There are two men in this paint room, each with two guns in a rack for primer and for two camouflage colors. Half of tank is sprayed with both primer and lacquer. This tank is rotated, end-loaded and opposite side is sprayed. Assembly line is constantly moving while this operation takes place.



Fig. 19 New tank is being to process conveyor and rotate through spray of hot alkaline solution to remove all material through material from tank prior to painting. None of these because to remove alkaline solution is given prior to tank's being coated through a hot air drying room. This room contains steam heated radiators which blow hot air at approximately 100 degrees against inside of tank, thus removing all moisture.



Fig. 20 Tanks to be moved and shipped rather than sent "by air" are coated with Parafinish as an additional guard against painted surface and corrosion.



Fig. 21 Service plug is placed in camp and tank is then subjected to a final paint spray, using a spray solution in inspection for tightness. Personnel using and flame adding system are not made while tank is still on conveyor system.



centrifugal casting machines are smaller and electric arc furnaces. The latter are holding an increasing share. From these are drawn the hollows of steel to be poured into the centrifugal molds. Each half is made of a standard size and a close flange is held on the amount of metal poured.

Centrifugal casting machines are arranged as a revolving turntable, the number of turntables being increased so that the required production can be obtained. Each turntable carries eight equally spaced casting machines. Two of the stations are used for unloading and loading, one for spraying the inside of the mold with a graphite mix, and one for pouring. The steel is allowed to solidify as the turntable swings through $\frac{1}{2}$ of a revolution, or approx-

imately three minutes. The cycle is about 15 min. per revolution, so about a minute is allowed for solidification.

The casting machines revolve on oil-greased shoes. Each is provided with a hose mounted on the turntable. In this hose are mounted four steel disks or pins. These are arranged at each end of the hose, and the cylindrical mold rests on them horizontally just as the axle of a grandfather clock on the small wheels on each side.

One pair of these rollers on the casting machine is driven by a motor located in the base. Push button switches on the base turn on the electric motor and automatic timer switches end the motor off. A lead, hinged at one side of the base, covers the entire mold when closed. It is operated by a hydraulic cylinder on the large side and controlled by a lever-operated valve conveniently located on the side of the base. This completes the complete casting machine.

The mold consists of a steel cylinder with openings in each end. Into the lower open end, a piston, like piece is inserted and clamped in tight by a yoke and nut screw. Into the small opening on the other end, a ring of dry sand is poured.

(Turn to page 330)

After weighing, each cylinder barrel is stamped with the heat number. This number is stamped on barrel every time it is machined and will be found on finished barrel so that heat analysis can always be obtained even after cylinders have been in service.



An assembled cylinder barrel went being swung into one of casting machines on turntable. Turntable is revolved until mold has two parts of rollers in casting machine and keep mold in place during pouring. Power drive rollers keep mold turning at about 150 rpm while in machine.



Working machine with load down and mold spinning at 150 rpm. Mold is hot when put in machine, and when it starts spinning it is covered with a coat of mold wash. This is done just prior to pouring.

Pouring steel cylinder with ladle designed to hold gases prevent it solid in pour one cylinder. This same ladle used on machining time.

After a two-minute cooling, mold is removed from turntable and put on roller-plate. Cooling is still not hot.



Two steel cylinder sleeves—one centrifugally cast and the other lathe-turned showing difference in finish when treated to destruction. Note that drying cracks along floor lines of material.



Finished centrifugally cast steel cylinder barrel after hydro static test of 36,000 psi showing low or bulged without fracture. Actual expansion in diameter was 0.0775 in.

Conservation Starves the Scrap Barrel



By C. G. SHAFER

Supervisor of Material Conservation, Fabco Aircel Div., Consolidated Fibrous Aircraft Corp.

A sheet in the stockroom is worth two in the scrap bin, and energy spent in reclaiming already wasted material is only half of a good idea. This expert tells how to jump the gun on unnecessary waste.

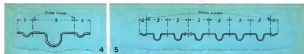
ONE OF LAST YEAR'S deductions between "inefficiency" and "conservation" of material began to receive adequate emphasis in the aircraft industry. Under impetus of the present economy for conserving every ounce of critical war materials, the value of true conservation has been spotlighted.

Now it is probable that conservation will slip into the shadows and be confounded again with reclamation, since the operative economy effected cannot feel of recognition as a fundamental of good management. Given a satisfactory scale of production, it is a tedious economy to begin by planning maximum use of

materials than to engage in the afterthought of trying to utilize remnants. A comprehensive industrial engineering survey will furnish data that, combined with cost accounting, indicates the extent to which could theoretically be made in conservation planning, as against the cost of reclaiming values from scrap. Critical changes in this and emergency have supplied a strongly modifying factor as factor of planning production for maximum material use. It is from this base that the Fabco Field Div., Consolidated Aircraft Corp., has made its approach.

A brief review of the industry's progress in achieving fast production will aid appreciation of the problem.

In the days of small contract requirements, aircraft builders found it expedient to produce with a minimum of tooling. Resultant waste of materials—which then was plentiful—was less cost



ly than the manufacturing methods conducive to conservation.

In those days, virtually every place was a make-or-buy job. Uniformity and interchangeability of parts were not attempted. As an outcome, rough draft tooling and correspondingly crude forming were done with a vice held against over-sized legs. There was greenhouse fitting and finishing, with a large margin of excess material necessarily allowed.

As contract requirements were increased, the principal effect of saving material was one of reduction. Greater effort was made to achieve usable small parts and metal from the material wastage inherent in this type of manufacturing, and to get each reclaimed material back into production.

Many companies are now in possession of almost unlimited contracts. Original planners and buying policies have been revised to effect interchangeability of assembly units and uniformity of fabricated parts. While the industry has made significant strides in the change over from craftsmanship to mass production, material utilization has lagged because of inability to produce materials of exactly measured widths, lengths, diameters, etc., and because, in the minds of many who have become accustomed to the accepted methods of aircraft production, there has been an unwillingness to face the fact that the aircraft industry has entered a new production era.

In order to utilize the aluminum and metals, material conservation properly finds its emphasis in design engineering. There, elements are selected and types of material determined in relation to the size, form, and function of parts.

Once in possession of information concerning parts design and material specifications, the tooling department is able to plan fabrication with a view (for instance) to nesting parts for punch press operations, eliminating material shearing and drop hammer practices. Heat treating and other secondary operations.

A conservation-minded industrial or production firm coordinates the purchase of material in specified widths and lengths of her stock, transportation, and sheet to elements waste due

to sheet ends, remnants, lathe turns, and the like.

Thus an approach is made toward true material conservation. There is good reason to believe that the industry is becoming cognizant of the importance of conservation, not only in saving the war but in governing choices for survival to individual competitors after the war.

The present position of saving from scrapings and reclaiming small parts, therefore, was studied through analysis of data gathered in a survey conducted by the methods and controls department. The industrial engineers assigned to the task found that certain parts dropped in the floor averaged (see Fig. 1) a definite percentage of any representative batch of scrapings. Since the nature of the parts to be recovered indicated the department at their origin, the material conservation department launched a campaign to reduce the amount of mildly wasted material finding its way to the floor.

Slotted bag work benches equipped with waste and anti-leakage beneath

assembly pans were devised to keep production parts out of floor scrapings. Analysis of nesting methods, and the application of industrial engineering principles in sorting tables, such as barrel sorting, came for better the help of outside engineers, so all items except rivets.

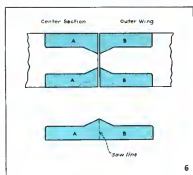
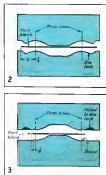
Similar disclosure of the causes of problems in waste, and the relation of recovery costs to extent of investment in better production planning to conserve them, has shown the way to removal of material conservation policies in keeping with the new aircraft manufacturing era. Here it may again be salutary to add the way whereby of fully utilizing each bit of residual material.

In general, the efforts of the Consolidated Fibrous material conservation department are being focused on departments such as engineering, tooling, and production. These departments are being improved with the appreciation their work provides for eliminating waste before a single leg, tab, or sheet is produced.

In some cases, special groups such



Fig. 1. Parts retained from floor scrapings. Percentages are based on 702.5 lb. of material retained.





By scrapping obsolete tools, heavily taxed, possible losses are less of critical metal can be reduced by other more important ones.



Four sweepings are dumped into hopper of this magnetic sorting machine and are separated in five bins by magnet. Heavier parts drop to a magnetic belt below the others.

to the material specification planning group, working under the costing department in coordination with manufacturing and material control departments, are established to set up manufacturing and delivery constraints. The planners, for example, determine definite stock requirements for each part, then derive means of improving existing fabrication methods.

Where stock levels are excessive, stock perfection cards are prepared. Then the planners agree on a working design; the card is checked up and a copy sent to the shopman. Formerly, the planners were noted at the machine by the operator, who decided, on the spot, what material to use. The most economical way. Through the use of the stock specification cards, the shopman's time is saved and a maximum economy of material is assured.

Another improvement initiated by the group, and perhaps the most noticeable to date, is described in Figs. 2 and 3. Fig. 3 illustrates a formerly used to fabricate a die panel deck. It includes a die lock which requires a 2-in. border of stock. These additional 2 in. were written off as an operating loss, until the planners went to work.

In removing the die (Fig. 3), 50% of the die lock, and running a head pass from the top surface, the die lock and its standard, opposite were eliminated. Then, by placing a blanket of rubber over the blank before passing, the operation was completed with the saving of a border of material 12 in. wide for each part processed. The operation was shallow enough to make the head and the rubber blanket an investment in effort to the die lock in crimping the part blank.

Actually, the result was a 90% part saving in material, since the new method reduced the size of the part blank sufficiently to allow saving of one part per sheet instead of the previous two. Based on current production, enough stock stock was saved by this step to build 35 additional Volvo 1900 four-door sedans.

Another contribution made by the material specification planners, as illustrated in Figs. 4 and 5. A "sublimator", or hot surface, required a strip of steel 7 in. wide. The part itself measured only 3 in. in width; the remaining 4 in. being returned by a 2 in. die lock allowance on both sides. These the planners were too deep to allow a change—made to the one illustrated in Fig. 4. The planners devised a new die (Fig. 5) in which eight parts were processed in a single operation. As a result, material loss was reduced from 57 to 17 percent.

Progress made to date by the material specification planners, over a period of four months, includes acquisition of



Here, furnace material is separated from non-ferrous. Note also steam vents in gas (background) and steel balls, wire, and welders (over).



Conservation of strategic material as these furnace steels in substitution of plastics for metal. Forward (background) are plate control. Back screen metal is replaced in lower models.

thirteen successful conservation programs, effecting an average material saving of 54 percent. From a total of 84,422 sheets of initial stock, 54,444 sheets were made available for additional use output.

The production department, too, has contributed an important saving by utilizing and improving the method of fabricating a heat treating steel in the production of the Volvo four-door sedan. Fig. 5 illustrates the assembly positions

of heat treatment and other work. Delivery heat treating and other work of each type, since the heat treatment were made in units and cut apart.

As time passed, sales for spare parts were paid for stripped those for repair surface spaces. Consequently, the stock of 8 parts was decreasing much more rapidly than the 4's. If the stock of 8 parts was continued, it was con-

cluded that the company would need up, at the completion of a given month, with a surplus of 8,524 8 parts. As now accounted, separate drawings for other 4 or 8 parts enable the producing department to adjust its orders according to customer needs.

The engineering department has played an important role by its continued efforts to substitute less critical materials. Plastics, principally Plexiglas



Conservation through use of multiple patterns, rather than by the previous employment pattern has made substantial cost that was in economy, heating, such as that shown, is thus made possible, with the greater economy of material.



Sorting of small parts has been greatly speeded by means of hoppers equipped with tube delivery in line, with drop holes arranged within one inch.



Isable parts are removed, where possible, from repaired parts, as in this instance where Elastic Snap Nuts and washers are salvaged by drilling out holding flange at ring center.



Remnants are secured before being loaded for storage. Blank sections are not sent through the material conservation department and Elko where possible from these released parts.

and Minuta, have proved equal or superior to the metal they replaced. For example, 6-in. Panalite is equal to 30B steel in the fabrication of non-stress parts, such as side panels and suspension covers. At the present time, approximately 75 percent of the Valves have been treated in a special plastic material.

Operational changes involving more efficient use of equipment, or actual re-

placement of it, has been of major importance in conserving critical stocks. Much of the work formerly done on drop lathes has been transferred to punch press units. The advantages of multiple lay-outs, reduced tooling costs, greater speed, elimination of the tool, and longer life of dies, are realizable in planning conservation prior to fabricating.

In making the above and similar changes, Valves Field Div. has saved

enough critical raw materials to build approximately 70 additional F4U fighters.

Material conservation, as a department, no longer feels its debt to the efforts of other departments. First, each department knows its own work best. By setting up a committee in the department itself—a committee whose record is judged by the number and quality of suggestions it makes—con-

(Continued on page 324)



The B.F. Goodrich Airplane of the month

DOUGLAS DAUNTLESS

LIKE A BARELY WIDE-OF-PART, a Navy SB2D accounted out of space and built its way on a victim before. Scratch another Jap!

That story was written in the Coral Sea... in the Gilberts... at Midway. This one carrier-based dive bomber, known as the "Dauntless," has been credited with sinking more, combining tonnage than any other plane in the Pacific. No wonder the Army adopted it too, calling it the A-24.

This month B. F. Goodrich, makers of Silverstone Tires, Deicers, Buick-Sebring Fuel Cells, and many other aviation products salute the Douglas Dauntless—a great plane with a glorious fighting record!



B.F. GOODRICH RUBBER RESEARCH FOR THE

Aviation industry

**SO OUR FLIERS WILL NOT
GO DOWN IN FLAMES**



NO WONDER his mechanic whistled when he saw the fighter's wings. They looked like lace-work. Near rows of bullet holes crossed and quartered along them, stitched by a Zero's gunfire. Yet this pilot just hopped out, grinned, and went below to file his report—"... one sure, two possible."

The "one sure" had vanished in a sheet of flame after one burst. The "two possible" had glided down on the sea after the last drop of fuel had run out through their coddled wings.

Chalk up one more lopsided American victory. And chalk up one more valuable American pilot and plane saved by bullet-sealing fuel cells. The Zeros didn't have them. His American plane did. Without them, he might have been a "flamer" too—he surely would have been forced down out of the fight. Instead, he was telling his fellow pilots how a Zero flame-grazes when a burst strikes home, and three Japs went wherever Japs go after diving for the Emperor.

Right here is where morale is born and enriched... in incidents just like this one. These grim don't take off heated by that ignorance of burning death which haunts the mind of every Jap pilot. Our men know their planes are built to take it as well as dish it out. They know their fuel tanks can be pierced by 10s, 50s, incendiaries, and cannon shells and still hold the gas to bring them home. Yes, bullet-sealing fuel cells mean peace of mind. They're one of the biggest reasons why our men dive in against terrific odds

without flinching... and come home to tell the tale.

B. F. Goodrich makes many of the bullet-sealing fuel cells used in our warplanes. We have pioneered many of the developments in fuel-cell construction that have given our fliers an all-important edge on the Jap... developments that are helping to keep our fliers' morale highest in the world!

A FEW B. F. GOODRICH DEVELOPMENTS IN FUEL CELL CONSTRUCTION

Developed leak-proof tank inserts... Produced first cells for 4-motor bombers... Developed synthetic rubber-welded assemblies... Applied latex-mastic principle of sealing... Developed effective adhesives for use in fuel-cell construction



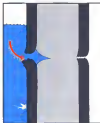
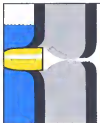
**MAKERS OF B. F. GOODRICH TIRES AND OVER 50 RUBBER
AND SYNTHETIC RUBBER PRODUCTS FOR AIRPLANES**

Why our planes can be shot through the heart

AND STILL KEEP ON FIGHTING!



A FEW BASIC PRINCIPLES will show how a bullet-sealing fuel cell functions. At the left is an actual fuel cell—one of the types used in our planes today. At right is a cross-section schematic, designed to show the main elements. (A) is the pressure-tight covering. (B) is a sticky, elastic material which strictly does the sealing. (C) is the counter-air, which is released in gasoline and aromatic fuels, and prevents fuel from coming in contact with the oxidant.



WHEN A BULLET strikes a fuel cell it passes through walls, as shown in left. The oxidant—a highly elastic, sticky material—is pushed aside by the bullet. After the bullet passes through the top of the wound some back to contact by these retensions and each together due to stick. If a perfect seal does not result immediately, fuel seeping in causes the system to over-heat and compounds the seal. B. F. Goodrich was fortunate in the development of this sealing method, called the bullet-mastic process—now accepted in the most advanced industry.



THE TERRIFIC FORCE exerted on a fuel cell when a .50 calibre machine gun bullet strikes it is demonstrated in this unusual photograph taken during long tests. A fuel cell placed over the open filling neck was hit by a solid column of gas from a .50 calibre machine gun. B. F. Goodrich fuel cells can be subjected to the force of many such hits without leaking.

In war or peace

B.F. Goodrich

FIRST IN RUBBER



FUEL CELL QUIZ

CAN YOU SCORE 100%?

There are ten true statements below on recommended maintenance procedure. Each statement is followed by three reasons why (a, b, c). Only one reason in each group is correct. Can you pick all ten correct ones?

- Cells should be at least 50° F. before removal is attempted because...
 - Cells "freeze" to place at lower temperatures
 - "Vapor locks" develop at lower temperatures
 - Synthetic rubber may crack if severely discolored at lower temperatures
- A man must always be stationed outside whenever another man is working inside a large fuel cell...
 - To watch out for open
 - To be ready to remove inside worker in case of emergency
 - To give inside man friendly advice
- If gasoline has penetrated large area in coating material, this area should be removed before repair because...
 - Gasoline will react in solvent and may eventually injure cell beyond repair
 - Gasoline-saturated material harbors gasoline
 - If not removed, spontaneous combustion may cause explosion
- Patching should always be done in a dry place because...
 - Moist air causes flux drip
 - Humidity or moisture makes good adhesion difficult
 - Moisture retards solvent
- During drying process, patches should be pulled apart to...
 - Allow fuel an solvent to evaporate and prevent harmful absorption
 - Discover hidden bullet fragments
 - Find "true center" of puncture
- Concrete should always be prepared immediately before using because...
 - Concrete loses proper consistency rapidly due to vaporization of solvent

- You need different types of cement at various hours of the day
 - Cement absorbs moisture from the air
- When making a repair, fuel cell should be buffed thoroughly because...
 - Buffing warms up the surface
 - Buffing smooths the surface
 - Good adhesion cannot be obtained without buffing
 - All buffed surfaces should be lightly waxed with solvent because...
 - It loosens up the cell wall
 - Small particles left by coarse cloth would prevent proper adhesion of patch
 - It primes the solvent
 - Vapors of acetone and solvents should not be allowed to accumulate in cell undergoing repair because...
 - Vapors are highly inflammable and might cause an explosion
 - Vapors may damage cell interior
 - Vapors cause patch failure
 - Cells with interior repairs should be dried for 24 hours at 50° F. before testing because...
 - This keeps water out of gasoline
 - Concrete need this thorough drying to prevent repair failure
 - This preserves fuel's octane rating

WHAT IS YOUR SCORE?

Each correct answer counts 20 % a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z, 100%



This is one of a series of maintenance quizzes prepared for ground crew members of the U. S. Army Air Force Technical Training Command. It is our hope that this series will help all maintenance men get maximum service safety, and efficiency from military-commercial and civilian aviation equipment.



Percutaneous, sometimes located in the rear section of the lower thorax, are used for measuring temperature on high altitude test subjects. Some indication of the complexity of the installation can be gained from the electrical group involved. Under complete flight test systems, provisions for all high altitude flights are definitely established and must be strictly adhered to.

Flight Testing Is a Sound Business

Part III . . . High Altitude Test Flying

By EDMUND T. ALLEN

Through case histories, "the greatest test pilot of them all" outlines procedures for safe, efficient test flying at levels where nothing but perfect functioning of both men and machines is acceptable.

WHEN A PILOT THAT THIS IS first required, or began to expand rapidly, operational procedures must be supplemented more slowly than in an older and consequently more stable organization. It has been the experience of flying that the precision which will enable the key men in the department to stay abreast of the rapidly changing situation calls for a daily concern.

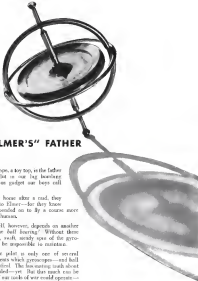
Meetings, therefore, are held each morning, presided over by the head of

the flight test department. In attendance are the test pilots, the flight test planning engineer, the flight test equipment engineer, the flight test analysis engineer, the flight test secretary, and the crew leader of each test airplane.

Rehearsed in test until 8:45 a.m., the meeting briefly summarizes the work of the preceding day, the schedule for the day, reports on the status of test airplanes, the weather, personnel report, test plans for the day, plans of other units or groups, individual schedules, action items, proposals for new tests, and miscellaneous items. Individual schedules result from the fact that during wartime, the entire flight test personnel must work long hours daily, installing instruments and frequently Sundays and holidays. Sometimes any man who serves individuals have personal

■ This, the last of three articles on flight testing by George Allen's Co., has been compiled from notes and rough drafts prepared by Aviation by Editor Allen prior to his death. Men who worked with Mr. Allen at Boeing, who aided him in establishing flight testing as a business here, have compiled the series of articles, but as they will carry to completion Editor Allen's flight testing plans.

Tom Morrow



THIS IS "ELMER'S" FATHER

This simple gyroscope, a key toy, is the father of the automatic pilot in our big bomber planes—the marvelous gadget our boys call "Elmer."

Often, on the way home after a raid, they turn the plane over to Elmer—for they know the pilot can be depended on to fly a course more accurately than any human.

The gyroscope itself, however, depends on another ingenious device—the ball bearings! Without these bearings, the smooth, swift, steady spin of the gyroscope's wheel would be impossible to maintain.

And the automatic pilot is only one of several "impossible" instruments which gyroscopes—and ball bearings—make possible. The low-maintenance tools about them cannot be overvalued—yet! But this much can be told now: very few of our tools of war could operate—or even be made in the first place—without anti-friction bearings which reduce friction, keep metal cool, prevent wear, and maintain precise location of parts.

NEW DEPARTURE ball bearings, in ever-increasing numbers, are flowing steadily into America's fighting machines.



Nothing Rolls Like a Ball

New Departure
BALL BEARINGS

mechanism as a dental appliance, which would require a portion of the diet for completion and might affect the flying schedule.

Downing for a hot fight at any altitude is determined in the morning meeting, and is based on such factors as weather, personnel, and the status of the airplane. Schedules are prepared the night before, by the flight engineers in charge, and sent to the hangar in order that the airplane may be made ready for the flight. The hangar advises the crew prior to morning meeting if "only" three may be sent.

The flight engineer in charge with his crew and other interested personnel of the flight conference. He distributes the mimeographed "plan of war" to the entire crew and other interested personnel at the conference. If this has not previously been done. This meeting is held in one of the numerous rooms of the Boring engineering building or at the hangar conference room, and each member of the crew becomes thoroughly conversant with his duties in regard to the particular flight. When the last engine man-out of the last airplane has been completed, the flight crew leaves for the hangar. If the conference should be concluded some time before the crew

plane is ready, the crew is dismissed with instructions to report to the hangar at a specified time.

Generally, the pilot and co-pilot arrive at the hangar 15 min. in advance of the rest of the crew. This gives them an opportunity to review the "change over position light" report and the "check sheet", in order that they may be familiar with the changes in the airplane. It should be pointed out that changes made in each airplane between flights will vary considerably. A large part of the high altitude research is done, not on the aircraft itself, but on special equipment which may be developed by Boring, or some other company, which has previously been tested and used in previous flights. It becomes an actual part of the Boring Flying Program.

Next step in the high altitude flight procedure involves assembling the test crew at the hangar. Here, each man obtains the necessary flight equipment. Trained to inspect the condition of his parachute, oxygen equipment, etc., each crew member must fill out a check-off sheet, verifying that he has performed these duties before he boards the test airplane.

After filling out the check-off sheet, the high altitude test crew reports to the engine unit for check inspection. Complete documentation is a necessary routine on all flights over 20,000 ft. Usually the engine used is a midget power of 2000, throwing a basket ball, shot or high school shot.

and subsonic, the American being about 30-40 mm. A dollar from the medical unit makes a brief examination of each crew member before he enters the plane, taking pulse and blood pressure and comparing with normal and some conditions of each person.

The crew then boards the Flying Machine, and with the pilot and co-pilot check the engine operation, the instruments, and check their equipment.

During the progress of the flight, all crew members, with the exception of the radio operator, wear an microphone. The radio operator is a large member to the crew members as each member in the plan of war is subdivided by the pilot, a signal has the crew members to play their role in that phase of the test. Once each hour, the flight engineer in charge reminds the crew members that they should take a glance again in condition peak efficiency, through the center of the light. If the flight is of long duration in the atmosphere, the flight engineer in charge reminds the

(From page 396)

To assure necessary and efficiency, Boring Aircraft's flight test department employs both manual and photo recording test instruments during experimental flights. Use of both types is required, since much of the equipment under test is tested at low sea pressures and pressures of high altitudes. New instruments are being installed in place provided about flying further. Not fluorescent lighting in role and human of part.



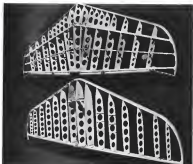
Duramold Speeds Stabilizer Production

By HERBERT CHASE

Molding process eliminates all seiling and produces a stronger, lighter stabilizer in less time, at less expense. Two prime advantages of this type of manufacture are distribution of weight according to stress patterns, and exceptionally smooth shaping of curved skin surfaces.

Production of the Duramold process in production at extremely low cost is being accomplished, perhaps, in the quality manufacture of stabilizers for precision training planes by the Duramold Division, Pittsburgh Aircraft & Engine Corp., of 45 New York plant. Methods of shaping the skin for these stabilizers are similar to those employed in other plants using the process. Although these concerns do not involve high expenditures, the skin has double resistance.

It is extremely significant, however, that skins prepared in this manner (in other words, with other changes in design which it helps to make possible) yield a final product which costs less and weighs less, yet can be produced more rapidly and results in a stronger, smoother stabilizer than the prior method in which the covering was made with flat sheets of plywood applied in the usual way.

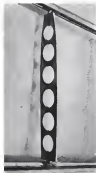


A-7 Photo by Edward J. Kelly, Photo Service

Obviously shown from the Duramold Stabilizer for a Pittsburgh trainer. Curved blocks are applied only in these center ribs. The assembly, later covered with skin, molded in its shape, which was covered with flat sheets of plywood and in one sheeting.



Wooden frame in which leading edge is formed in shape from several pieces of spruce. Reinforcing wires, glue is used. When area now constructed from spruce has in between resistance adding on side frame and pressure blocks to supply heat.



Detail of molding and frame structure where ribs join leading edge and spar of stabilizer.

Once these are given, the first time, details of the whole following process. These include production and fabrication of components of the stabilizer frame, its assembly, and application of the skin, as well as of the method by which the skin is prepared.

There is an important reduction in the number of glued joints where skin joins the leading edge and spar. Fewer ribs are made possible by the method of molding and applying the skin and its inherent strength. Curved blocks are eliminated, as are all nails. All joints where the ribs join spar and leading edge are of machine and frame type. These help in making smooth, but a saving gain in the respect results from carrying the thickness of the skin with proper relation to the stresses imposed, rather than being physical of radius thickness. In other words, instead of glued where it is needed and, for a given factor of safety, there is no increased extra weight.

Fabrication of stabilizers starts with the gluing together of eight 1x6 in. pieces of spruce for the leading edge ribs. Before the area glue sets, each ply is bent to the elongated "C" shape of the leading edge, as curved in plan form. Strips are bent around and fastened against a constant die by specially shaped



In this factory, designed to mold large a truck, airplane and motor car 400 is a leading edge, only the center portion of which is seen, by tool in machine supported on rollers. This portable tool is used in one machine holes, are being noted accordingly in such of in shaped portions of jig.

pressure blocks held by springing metal clamps. Both die and pressure blocks have inserted in their surface resistance. No screws or bolts are required to parts them after clamps are in place. The mold application of last gently, coordinate glue setting.

Assembly creates in the form 15 min with heat on, an additional 15 min with

heat off. Contact die and blocks are covered with paper to prevent glue from curing back, to adhere to the die. After standing over night for complete curing of glue, the assembly is soaked with three lead-edge holes.

The box is then run through a cavity shaper in level edges. In the next operation an abrasive plener, guided by

Ribs, spars, and leading edge are assembled in die fixture by gluing and shaping. Only a slight amount of fitting is required in effecting this assembly.





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Making a lay-up of plywood sheets ready-cut to approximate size. Adhesive beads have glue at right angles, and are secured with Tego film. Tacks drive staples along one edge to prevent sheets from sliding.

laid along a datum, taper the glue each way from nose to tip. Next, pieces go to a window where following contours are cut, the piece being fastened to a steel fixture. Steps on this fixture control the length and position of contours which come between marked holes for ribs (lower). These holes are made with a portable drilling tool attached to a frame which is slid along railroad surfaces of the fixture. The triangular end cuts holes which are the shape of fuselage and have straight sides.

This operation completes the leading edge lay-up. There are, however, several exceptions. Each one of these gland joints is examined and a piece is rejected if the thickness of any glue line exceeds that allowed.

The other steps involve the side floats below the rear spar, which is built up from three sections, the center web being three-ply thick and the two end strips spruce. Laying and sanding holes are started as the end strips before they are glued to the center web, metal plugs being set in the mortised holes to prevent glue from entering them.

Glue is applied to the end strips with a sprayer and end, after the strips are laid in place, the assembly, which is shapely, is placed in a redraining pit. Between the restraining pit and the assembly there is a pressure tube which applies even hydraulic pressure during the curing operation. In order to eliminate the great number of gaps which would be required for this high production if each assembly had to be made (Turn to page 316)



Back with two loaded molds is rubber bag being pulled into position. After bags are released by constriction in a vacuum pump, and another sheet, steam is admitted under 100 lb pressure to flat and cure resin. This change plus all by tips in molds imply pressure exerted by steam. Bags are sealed by clamps over a bar (lower).

Stabilizer is a separate area also is glued in lower. The two lower edges of ribs are rounded and bent up leading edge are rounded and sealed in third with vacuum. Trailing edge is placed in right. Although the ribs represent ridges due to the plates, it has double curvature and the same profile.

Effect of Scratches On Fatigue Strength of Alclad Sheet

By H. J. ANDREWS and G. W. STICKLEY,
Aluminum Research Laboratories, Aluminum Co. of America

There is a great difference between "defective sheet" and "sheet with defects"—yet the latter has too frequently been used as a criterion for rejection. Conclusive tests, described here, show that scratches more severe than those encountered in service do not seriously effect fatigue characteristics of Alclad sheet.

ONE of the most difficult tasks in preparing material specifications is to define the degree of perfection of surface required—and to do so in a manner that will truly distinguish between "safe" and "unsafe" material in terms that can be applied profitably and interpreted uniformly by inspectors personnel.

Specifications cover this writer with the statement that "the material shall be free from hydrogen defects." Obviously, that statement falls utterly in providing a usable standard of quality, but no one can, yet, succeed in securing a correct and pertinent statement. No witness is believed of those responsible for preparing these specifications. This situation is mentioned here because no one can ever learn from ignoring it.

Furthermore, the term "defect" is frequently used very loosely. "Defect" itself means "defective." The term "defective material" should not be used if the word "defective" is confined to mean "unsafe." With our knowledge now founded in long years of service experience, no one would contend that a slight surface scratch makes a piece of

sheet unsafe for use, yet people loosely refer to all kinds and sizes of surface blemishes, short of catastrophic perforation, as "defects."

Recognizing the foregoing, it would seem that the only practical solution to the problem is the accumulation and dissemination of data showing the effect

of these conditions upon the properties and performance of materials.

Considerable progress was made in 1942 when the permanent specifications groups, relying on some considerable data, agreed that scratches in Alclad 24S-T sheet—if they did not penetrate through the aluminum coating and into the alloy core—should not cause rejection of the sheet. Likewise it was agreed that only seldom did a scratch penetrate that far. This article aims to supply further data justifying the decision of the permanent agencies.

Some of the properties lost might, in the minds of some people, be considered limited are the tensile properties, ductility, resistance to corrosion, and fatigue strength. In an article by Nagel in the May, 1943 issue of *Metals Progress* entitled "Some Specifications for Defense Quality Aluminum Alloys," Production, but this view presented elsewhere but scratches which severely score to Alclad sheet have no effect upon tensile strength, cold-chamber strength, and elongation. Tests demonstrated that local stress is not relieved. Based upon other available information, Nagel also stated that resistance to corrosion actually is not harmed.

In considering the effect upon fatigue strength, information lost data are not available, therefore Nagel had to rely upon service experience. That again indicated that scratches usually occurring in production are not of serious consequence, especially in view of the fact that the scratches that score into an airplane is not as serious as many numerous and continuous of greater size.

While this case in the production and processing of the material.

As described in the following paragraphs, some tests now have been made to evaluate the effect that scratches may have upon the fatigue strength of Alclad sheet. The artificial scratches used represented conditions much more severe than those normally occurring in service, and probably also were more severe than those used in the tests described by Nagel. For this reason, two sets of tests were made in addition to the fatigue tests. The sheet used was Alclad 24S-T, 0.004 in. thick.

The "scratches" consisted of single 60 degree sharp V-scratches cut across the surface of the specimens and closely opposite each other. Each was made with a single cut in a sharp edge the cross fully ground and shown in Fig. 2. From this photograph, made at 100X, it is evident that the tool was very sharp, the radius at the tip being less than 0.0001 in.

Two depths of scratches were studied, one equal to about half the thickness of the Alclad coating and the other the full thickness of the coating. The cross sections of a scratch on each of two typical fatigue specimens are shown in Fig. 2. The view of the surface of the surface, the end of each scratch was cut as deep as the tip of the cutting tool. Also, it should be noted that there was a transition for the metal to pile up at the edge of the scratch, giving the scratch an exaggerated appearance.

In all tests, both tensile and fatigue, the specimens were taken cross-section, and the results were not reported in the direction of rolling and on each surface of the sheet directly opposite each other. This was not parallel to the direction of rolling because any effects would be expected to be most severe under these conditions. For comparison, tests of the same material also were made using specimens without scratches.

The tensile tests were made using ASTM standard specimens for sheet, with the scratches located at the center of the reduced section. In one group of specimens the average notch depth of scratch was 58 percent of the coating thickness, and in the other group it was 105 percent, the scratches in the latter group actually penetrating the core metal about 0.0003 in.

In general, the results of these tensile tests confirm those reported by Nagel. As can be seen in our stress-strain curves, effects of scratches on tensile properties, scratches of either depth had no definite effect upon tensile strength or yield strength. Also, the slightly lower elongations of the specimens with scratches cut approximately halfway through the coating, as compared with that of specimens without scratches, is not significant, especially in

view of the fact that the locations of the fractures were not at the scratches. The scratches which had a depth equal to the coating thickness, however, did lower the elongation slightly and the fractures occurred at the scratches.

The fatigue tests were made using the center-hole tension specimens shown in Fig. 3, which is proportioned so that a reasonable length of the specimen is subjected to a uniform bending stress. The scratches were located at the center

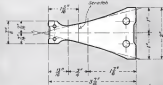


Fig. 2. Fatigue tests were made using center-hole tension specimens shown here.

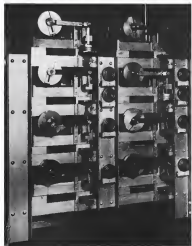


Fig. 4. Repeated flexure machines for fatigue tests of sheet.

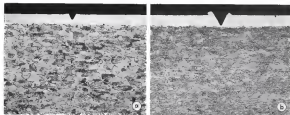


Fig. 3. Cross-sections of typical scratches in fatigue test specimens. Specimen (a) was cut approximately half the sheet coating depth. Specimen (b) was cut nearly the full coating depth.

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HELPING TO WRITE
THE STORY OF TOMORROW

BOEING AIRCRAFT CORPORATION, CLEVELAND, OHIO, CALIFORNIA

AVIATION, June 1943

In our group, the average actual depth of scratch was 50 percent of the resting thickness, and in the other groups it was 80 percent; the scratches in the latter group being not quite so deep as those in the corresponding group of treated specimens. The specimens were subjected to completely reversed bending stresses in the repeated

Effects of Scratching on Tannin Preparation

Aluminum 11-1000 G.	Alloy Type 4-2024 Temp. 10 in	Temperature Material at down to 10 Temp. at 10 Constant Exposure	Thermal Stress Pa	Yield Strength at Temp. 10 MPa (ksi)	Change in Yield Strength MPa (ksi)
0.0015	0	0	0	11.000	0.0
0.0015	0.0015	0.0015	0.0015	11.000	0.0
0.0015	0.0015	0.0015	0.0015	11.000	0.0

* All 14 groups began with an hour of full range of motion

each group was forced to feed at a very low adjacent to the nozzle.

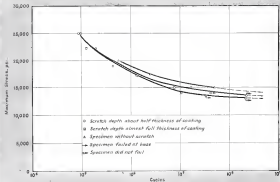
We can summarize the results of the tests on full-fledged birds by stating that even the deepest scratches need not in fact upon flexion strength and yield strength, and vice, had only a small effect upon elongation and fatigue strength. It should be remembered, however, that the conditions used in these tests unduly stress the material more so than those that occur during actual landing of the bird's foot. As noted by Nagel, elongation has shown that scratches resulting during landing may prove the making of well high tensile and/or

The tests also represented an extreme condition in that the test used a working life method whereby the maximum number of working hours was chosen to be 160 h per month.

stretching. Furthermore, it is highly probable that such deficits may also result in the development of such other as both surface and shear, as was the situation in the test specimens. Later now, the kind of repeated stresses, which were bending stresses, increased varying from zero at the neutral axis to a maximum at the outside of the sheet, repeated fatigue conditions, probably mean that these are severe conditions.

In setting the sheet, it should be subjected to many uniform and stresses. Therefore, it can safely be concluded that materials that are showing the small bending and relaxation of Alkaloid have life, it may, effect upon follows strength, thus positioning the ruling that materials which do not pass true through the dimension testing and into the raw are not meant for selection.

Fig. 4. Breaks of fatigue tests.





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 4. Airing other critical materials for what important jobs.
 5. Providing correct handle for designers.
 6. Doing things that "can't be done."
- ✓ **It's, leading to improved machine and product performance.**

INSUROK

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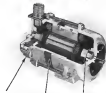
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Photo courtesy of Lockheed Aircraft Corp.

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Light weight—special light construction as well as use of light weight aluminum in housing.

Light weight—special light construction as well as use of light weight aluminum in housing.

Air transport—playing an ever greater role in the war—took a big step forward with the recent model flight of the Lockheed "Constellation." Many of these remarkable planes will soon be winging their way into the battle zones, carrying men and supplies where they are needed most.

The electric accessory motors on this plane make possible its successful operation by driving such devices as wing flaps and fuel pumps without failure. Some of the Constellation's electric motors are Bodine motors. They meet or exceed Air Corps requirements for light weight, dependability, durability, and quiet construction. Extra care in manufacturing makes them consistently reliable. That's why you'll find dependable Bodine motors widely used in the aircraft of today and tomorrow.

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FRACTIONAL HORSEPOWER MOTORS

Quality Control Keeps Product Standards High

By HERT HOLLAND, Quality Manager Ryan Aeronautical Co.

Speedy correction of errors at their source is the best guarantee of uniform production. Finding the cause is time to prevent rejects and waste is the problem — and it has been met with notable success by the practical system unfolded here.

QUALITY CONTROL is a major item on the list of the aircraft manufacturer of which is a definite step toward economy and increased production without sacrificing quality. In other words, quality control is the greatest asset of the manufacturer's reputation for the production of high quality products.

It is by controlling and destroying the gross responsibility for poor quality that quality control is made most efficient. This dangerous little germ in the common methods and is thrown in every manufacturing enterprise in the country. Through efficient organization, close and careful cooperation, concentration and constant employee teamwork, the germ is destroyed and serious mistakes are reduced to a minimum.

One quality control department can

organize for the sole purpose of inspecting and maintaining this control. The department is a high-speed, steam-boosted, and far-reaching organization, but in order to appreciate the importance of its place in the aircraft industry, one must acquire a thorough understanding of the department's main inspection duties, some of which may be defined as follows:

Departmental Duties

1. Inspect the causes of all rejections and employ the necessary means to eliminate them.
2. Supervise all salvage operations.
3. Find out and take steps to eliminate all manufacturing conditions which may become causes for rejection.
4. Cooperate with the production de-

partment in the development of more efficient methods to improve quality and avoid rejection.

E. Example standards to show final tests and methods needed to a result of rejection and poor manufacturing methods.

F. Avoid the subcontractors and vendors in developing and manufacturing the highest possible degree of efficiency from their respective departments.

G. Co-operate with the outside production department in determining the qualifications of all subcontractors and other outside sources of supplies.

H. Determine and advise their department whether or not outside sources can produce products which conform to Ryan standards of quality and workmanship.

I. Deal with our customers on production pertaining to the quality of work being done for them.

J. Endeavor to uphold at all times the Ryan standard of quality and performance.

Classification of Departmental Duties

All rejections are reported to the quality control office by means of our Inspection Rejection Report (see Fig. 1). Upon receipt of this report, a member of the quality control house staff conducts a thorough investigation to ascertain the nature of the discrepancy. Having determined this, he then proceeds to find the exact cause of the discrepancy, then he prepares a rejection report to the quality manager giving him all the details. The quality control officer then explains the reasons involved to eliminate the difficulty by preparing an Quality Control Rejection Report (see Fig. 2), recommending a recommendation for corrective measures and indicating when it is indicated or discontinued.

If all salvage activities are carried on by the quality control department. For this work, a staff of salvage engineers and house men is maintained under the supervision of the quality manager. The salvage division handles all salvage cases which require the services of salvage or other personnel.

C. Coordinate conditions which may become causes for rejection are reported to the quality control office by members of the quality control house staff, by the inspection staff, and, in some cases, by members of the production personnel. Upon receipt of such

FIG. 1

information, the quality manager conducts a thorough investigation and then makes the necessary recommendations to the proper authorities.

If the quality control house staff is constantly on the alert to detect rejections and out-of-date methods. When any such conditions are found, they are immediately reported. The quality manager then conducts a personal investigation. If same shows methods to improve quality, avoid scrap, and expedite production can be applied, the necessary recommendations are made to the proper authorities.

E. Staffing on finished items and materials issued as a result of rejection and poor manufacturing methods are compiled by the quality control

department. This report information, submitted to the quality manager daily, is contained in his graphs showing the number of parts accepted, rejected, and scrapped. These, in turn, determine as to the percentage of parts or work is accepted or rejected to the number accepted on any particular order. We consider this an important phase of quality control in that it gives a warning when trouble comes into the production line and not otherwise reported. Investigations are conducted on all subcontractor conditions which appear as the graphs.

F. The department maintains an outside quality control supervisor and staff of house men who handle outside quality problems. Constantly in contact

with outside vendors, they represent themselves with the latest problems and make recommendations where necessary to maintain the highest possible degree of efficiency.

G. Qualifications of all subcontractors and outside sources of supply are determined through close observation. If satisfactory conditions are reported, same are noted.

H. The quality control office is in touch through the Inspection Rejection Report prepared by the receiving section department and when a trend or parts received from outside sources are not coming in proper standards. When such a report is received, the quality manager informs the outside production and outside quality supervisors of the discrepancy and have them immediately take steps to eliminate the condition.

I. The quality control department is responsible to the Army, Navy, and other customers for every item of work produced for them by Ryan. If difference in opinion should arise between members of the Ryan personnel and those of our customer's inspection personnel, the details are reported through the inspection office to the quality manager whose responsibility it is to secure a satisfactory understanding with the customer.

J. In accordance with the duty of upholding the standards of quality and performance, all of the above functions are directly related to this problem.

Discrepancy Report

When greater responsibility is attached to our discrepancy reports and procedures for handling them than to any other item sent by the quality control department, it is believed that a thorough explanation of the place of our work should be given.

The discrepancy report system is composed of three sets of sample forms and is submitted after manufacturing. The first of these forms, shown in Fig. 1, is the Inspection Rejection Report used whenever a mistake is uncovered by the worker who prepares the report in detail. This form is used immediately on the spot and is shown immediately to the quality manager, who then takes action as to the nature of the mistake. The second set of forms, shown in Fig. 2, is the Quality Control Rejection Report used whenever a mistake is uncovered by the worker who prepares the report in detail. This form is used immediately on the spot and is shown immediately to the quality manager, who then takes action as to the nature of the mistake. The third set of forms, shown in Fig. 3, is the Quality Control Rejection Report used whenever a mistake is uncovered by the worker who prepares the report in detail. This form is used immediately on the spot and is shown immediately to the quality manager, who then takes action as to the nature of the mistake.

In the lower left hand corner is shown the department believed to be responsible and the date reported, while in the lower right hand corner appears the signature of the company inspector

ORGANIZATION CHART RYAN AERONAUTICAL CO. QUALITY CONTROL DEPARTMENT



[illegible]

FIG. 2

Learning the neckline which caused it (go as far back as the Times report on the back of the blue copy) we are now in a position to take necessary corrective measures.

In order to accomplish this, a second form the Quality Control Discrepancy Report (shown in Fig. 2), is immediately prepared by the quality control department. This report picks up the serial number from the first copy of the Inspection Discrepancy Report and is addressed to the department and to the attention of the individual believed to be responsible for making the correction.

This letter is very similar to the Inspection/Discrepancy Report so that it carries much of the same information, but in addition, at the bottom of the form a space is provided for the quality manager's recommendations. The Quality Control Discrepancy Report is prepared in duplicate, with the original immediately delivered (not mailed) to the addressee and the carbon copy attached to the Inspection/Discrepancy Report and placed in the quality control supervisor's file on the file.

Since it is important for the quality control department to know at the earliest possible moment what action is taken by the department in whose the report is directed, a third form, Reply to Inter-organism is prepared in part by the quality control department and attached to the Quality Control Discrepancy Report before delivery. This form is addressed back to the quality control department. It also carries the serial number of the Inspection Discrepancy Report, the assembly number, name, of

In the lower portion of this reply form, a space is provided to show what action is taken. Since the upper portion of the form is prepared by the quality control department, it is only necessary for the addresser to indicate the action taken. If it is the date, add sign and return (ack mail) to the quality control department. Upon receipt, the reply is turned over to the quality control supervisor who indicates that the action is satisfactory. If such is the case, the addresser will receive the signed (init, local, owner), return the form to the office of the Inspection and Quality Control Directorate Reports Team. The following day, the addresser will receive and handle them over to the quality control.

It was because necessary to notify the inspection officer to whom the original of the Inspection (Inspection) Report was addressed, the customer's inspection who is holding the green copy in his file, and the company inspection as shown the yellow copy is being held, that satisfactory corrective measures



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Abstract **Keywords:** self-esteem, self-esteem threat, self-esteem threat, self-esteem threat, self-esteem threat

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It may be noisy a moon before any material is tight and strong as a spider's web is developed. The arachnid engineers are using flylarvae, stronger materials than ever before. One of them is *Syrphoctonus balaenae*-inspired, a thorax forming phasic plastic. Light is weight? Yes, about half the weight of aluminum (Fig. G, 14). Strong? Yes, strong enough for cable without metal, clearest, heaviest, heaviest.

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TUBE TURNS
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Tube Turns recently set a world's speed record in forging cylinder barrels for airplane engines. Big "S" specifiers produce these forgings with extreme precision as well as speed. Another Tube Turns achievement is the fast, accurate forging of aluminum pistons with complete dies at Macgregors. Tube Turns' forging "know how" and engine facilities assure the quality and quantity needed in both operations. A Section of engine, shown, a large cylinder barrel forging. Below, a Tube Turns aluminum piston forging.

TUBE TURNS (Inc.) Louisville, Ky.

TUBE TURNS

CYLINDER BARREL AND ALUMINUM PISTON FORGINGS

High Output Generating Systems

By W. F. FELL

Chief Electrical Engineer, Edgemo Aviation Div., Bendix Aviation Corp.

Greatly augmented electric loads on our glint aircraft posed a tough puzzle—because these loads could not be met at existing generator speeds without units of excessive weight. But today that problem has been solved by high-speed engine-driven generators and e.g. voltage regulators.

That constantly increasing electricity—of large, long-range multi-engine bombers and transporters in military operations, and the projected future development of large long-range strike boats and cargo planes for commercial requirements have been impossible for the progressive growth of electrical power supply systems in sufficient response to handle the large increase in electrical load.

When it became evident that the electrical loads on airplanes would be greatly augmented and that generators required to supply these loads at existing generator speeds would be of an undesirable size and weight, it was realized that an increase in rate of generator drive speed to engine crank shaft speed would provide a satisfactory solution to the problem.

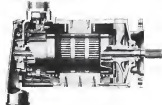
Through the cooperation of the various engine manufacturers, drive speeds on two engines of high output have been increased from the normal 1,644.2 rpm to approximately 3,500 rpm, thereby making possible the use of generators of high output without sacrificing the size and weight limitations dictated by aircraft engine design.

In addition to more engine requirements, it also became evident that because of increased electrical loads it would be necessary for standby purposes to equip large long-range airplanes with an auxiliary power supply system consisting of a light-weight generator engine, driving a 300- to 600-watt generator, that would be capable of supplying power when the main engines were at rest or idling, and which would carry a sufficient part of the airplane electrical load in emergency operation of the electrical system even though one or more of the main aircraft engines were out of service.

It was further apparent that large airplanes, when operating in low altitudes, could effect much greater fuel economy by operating main engines at a decidedly



Fig. 1 (above), Edgemo P-2 generator designed for installation of high speed generator drive. It is used at 200 v., 400 amp at 6,000 to 10,000 rpm. Fig. 2 (below), Sectional view of P-2 unit, incorporating both low and high speed, generator is suitable for application on auxiliary or main engine high-speed emergency drives.



lower running rpm than had previously been considered standard, provided that more engines generators would deliver sufficient electrical output for these lower engine speeds.

Generator Characteristics

To provide a generator of sufficient capacity which would take into consideration operating conditions, applications, and engine limitations, Edgemo Aviation engineers, using the Army Air Force P-2 engine specifications as a basis, have developed a 6 kw generator which is suitable for both auxiliary and main engine installation and, at same time, takes into account variations in airplane cruising speed. As a result of this research a generator of low size and weight, 30 lb. now developed—a unit that is both fan and blower cooled

and will deliver 500 amp at 30 v. continuously, thereby providing 20 power-supply and emergency outlets. The generator will produce a full rated load of 500 amp at 30 v. continuously or 6 kw. over a speed range varying from less than 3,500 rpm to 10,000 rpm.

To provide satisfactory operation at low cruising speeds encountered in large long range bombers, transporters, and flying boats, the 6 kw generator was designed to deliver three-quarters of the rated output at speeds as low as 3,500 rpm. In addition, fan cooling was provided to permit satisfactory operation in non-very power plants, providing 30 v., 500 amp continuously at 6,000 rpm without any other cooling means. Thus that supplied by an own interest fan.

Thus, it can design this generator, with its alloy steel mounting flange, pro-



Little more than 3½ years ago, the first of the new vintage Lockheed Hudson Reconnaissance Bombers—born of a Lockheed Transport cockpit and a former British Commonwealth fighter—was delivered to England. (Photo courtesy Lockheed Aircraft Corporation.)

OSTUCO helps American fledglings steel themselves for combat

Yes, little boy, you're both pretty young. But airplanes grow up much faster than little boys these days. They've got to because they have a main job to do. And if you could read the paper, you'd know they're doing it.

On the other hand, veterans like OSTUCO have embraced their jobs to keep up with these American youngsters. Some OSTUCO workers are old enough to remember two other wars. In the first, they were making seamless tubing for bicycles and boiler tubes; in the second, their production was principally for motor transport, engine parts, axles and bearings. Now, in an armed conflict, these same workers are busy on seamless tubing for such aircraft parts as the brake shaft assembly, strut support brace assembly, strut assembly, support assembly on coolant radiator, engine control clamp assembly, rudder pedal torque, fuselage and engine mount.

And here's something else to think about, little boy. OSTUCO's strict adherence and fast adaptation to AMS and AN specifications now, forecast its ability to keep step with aircraft manufacturers' quick production shift from war planes to planes for peacetime battle and transport. OSTUCO tubing supplied to close G. I., I. D. and wall tolerances, finished and formed as required, will be a valuable asset in keeping production up and costs down in competitive production.

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THE OHIO SEAMLESS TUBE COMPANY



vibes a reliable source of power that will withstand the shocks and vibrations encountered on more arduous engine drives, produce sufficient output for low starting speeds, and operate off-model on accessory power plants.

Referring to the semi-enclosed view of the P-2 generator is shown in Fig. 2, it is to be noted that many innovations have been incorporated in the design of this unit to assure dependable performance under all operating and load conditions. Adequate cooling for both main engine and auxiliary power plant operation has been provided by means of the integral cooling fan and air space for blow cooling, which permits circulation of air through the hollow structure shaft. The generator incorporates a floating type of flexible torque shaft which is normally aligned to the hubner armature shaft at the nonrotator end of the unit and held in place by means of a lock ring. And an internal drive spline is provided on the drive end of the flexible torque shaft which extends through the back head and engages the engine driving member, thereby absorbing engine induced vibration and compensating for any slight drive misalignment. The armature shaft is mounted on parallel shafts, sealed ball bearings which prevent entrance of any dirt or other foreign matter into the bearings and assure efficient lubrication under conditions of blow cooling.

To increase surge-all generation efficiency and improve commutation, the generator has been designed to incorporate both untapped and compensating coils which are connected in series with the positive generator brushes. These coils develop magnetic fields which are proportional to the load current and opposed to the magnetic field developed in the armature core by the flow of load current through the armature coils. The untapped and compensating coils thus prevent armature reaction and maintain voltage free energy destructive sparking at the generator brushes under all load conditions. With this type of design it is unnecessary to adjust brush location to eliminate sparking at the commutator.

In an effort to facilitate service maintenance, serious consideration has been given to the design of the brush support, which is freely accessible for brush replacement and adjustment of brush spring tension upon removal of the window strip. In addition, every effort has been made to increase brush life under high altitude operating conditions by the use of improved brush material.

Carbon Film Voltage Regulator

The effectiveness of any generating system cannot be judged on the merits of generator design alone but must be based on the voltage regulator with which

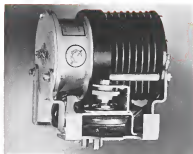
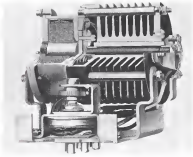


Fig. 3 (above), Cooper's Type 900 carbon pile voltage regulator for use in conjunction with single voltage generators rated from 12 to 6 kw. Fig. 4 (below), Type 1000 unit in sectional view. This device regulates generator output for both single and parallel generator systems.



the generator is to be used. In the past, the generator designer was involved in attempting a better voltage-power ratio, not only in lowest generator drive speeds possible but also because of limitations placed upon him by characteristics of available voltage regulators. Since the only condition normally in use with aircraft generating systems were of the constant type, it was necessary to restrict field currents of gener-

ator designs to approximately 1.3 amp. per amp. rated operating conditions, in order to assure reasonable life of regulator contacts.

It was evident that if a voltage regulator could be developed that would carry current of approximately 4 amp. under several operating conditions and dissipate approximately 75 w. continuously, the generator designer could at least double his variation current and

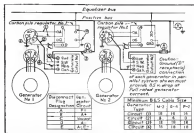
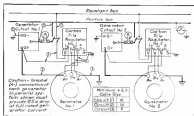


Fig. 3 (above). Typical schematic wiring diagram installation of Type M2 M2 and P3 generators with Type 1042 carbon pile voltage regulator. Fig. 4 (below). Wiring of company's N75 generators with Type 1005 carbon pile voltage regulator control line. For parallel operating systems, any number of generators may be connected in the manner depicted in three diagrams, while for single source, generator No. 2 and its associated equipment and connections are omitted from the system shown. Also to be omitted are the regulators and connections to the D and E (Fig. 3) and J (Fig. 4) carbon pile voltage regulators, with one of a complete, single line bus each.



SPECIFICATIONS OF CURRENTLY AVAILABLE EOLIPSE GENERATORS WITH CORRESPONDING REGULATORS*

Type	Generator	Volts	Amperes	Rated Power	Weight (Lbs.)	Full Load (Lbs.)
M2	Generator	24	50	1,200 W. at 24	35-36 (30-32)	70
P3	Generator	24	200	4,800 W. at 24	115-120 (90-100)	230
N75	Generator	24	200	4,800 W. at 24	115-120 (90-100)	230
N75	Generator	24	200	4,800 W. at 24	115-120 (90-100)	230
N75	Generator	24	200	4,800 W. at 24	115-120 (90-100)	230
N75	Generator	24	200	4,800 W. at 24	115-120 (90-100)	230
N75	Generator	24	200	4,800 W. at 24	115-120 (90-100)	230
N75	Generator	24	200	4,800 W. at 24	115-120 (90-100)	230
N75	Generator	24	200	4,800 W. at 24	115-120 (90-100)	230
N75	Generator	24	200	4,800 W. at 24	115-120 (90-100)	230

*Regulators shown with generator. Actual weight shown on a 1000-psi. voltage regulator.

As long as magnetic circuit is made lighter, desirable, thus achieving a more favorable weight-power ratio. For high output generators, field currents of between 10 and 32 amp. would necessarily be encountered under certain operating conditions. With such interferences, short circuit file, and deflection currents, obtaining these high field currents, use of other voltage control as well as type-1042 control regulation was precluded.

To take advantage of the weight saving that could be accomplished in the generator and to eliminate the drawbacks associated in other types of high field current regulators, Eclipse has developed, after considerable research, a series of carbon pile voltage regulators to handle readily all aircraft engine generating systems in present or contemplated use. Prior to the development of this specific regulator, much consideration was given to the elimination of the shortcomings of regulators of the contact type. As a result, the regulator is carbon pile voltage regulation, but with single voltage having changing generation, a wide percentage, dynamic motion, and auto-generator sets are now being produced in quantity.

A reinforced case of an Type 1042 carbon pile voltage regulator, designed by plug into a standard, only known, is shown in Fig. 4. This unit is for regulation of the output voltage of direct current generators rated from 1.5 to 4 kw. In other single or parallel operation. The regulator is made of a shock of carbon disk, held in a supporting housing, which incorporates features to facilitate the dissipation of heat. Carbon contact gages of either end of the disk provide electrical contact to the carbon pile. Pressure is exerted on the carbon pile by a series of radially arranged leaf springs, which act on the carbon contact plug at one end of the pile. The data shown in these graphs is controlled by the attention of an electrician, as well as an electrician attached to the engine. The regulator has a main-hand working and an additional hand-operated winding and when the generator is not available, it is adjusted in parallel with other generators.

The output and carbon pile bearings are mounted to a mounting bracket to which are also attached terminals and a standard for maintaining the contact in the separate coil. Six contact gages are arranged on the bottom of the mounting bracket, and in these are attached the lead from the resistors, and the winding and carbon pile. The regulator is designed to be superior to any other design, in that it will be present when subject to drive output. Weight of the Type 1042 Regulator shown is 28 lbs.

(Turn to page 339)

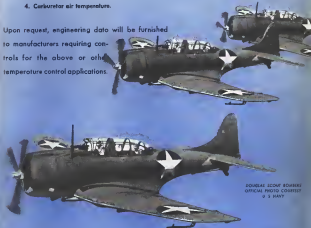
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4. Carburetor air temperature.

Upon request, engineering data will be furnished to manufacturers requiring controls for the above or other temperature control applications.



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Sta-Kon Disconnect Splices are made for wire sizes No. 22 through No. 10 Aircraft. Because it is a Pressure (Solderless) Connector, it is quickly installed with standard Sta-Kon tools.



The diameter of this streamlined splice is no greater than that of the wire itself. Drawing a piece of synthetic tubing over the fitting, completes the job.



The slotted coupler section is a high-tension alloy spring. Tips are in constant, side-area contact due to the pressure of this strong spring. The electrical performance of this splice exceeds that of an equal length of wire. All parts are silver-plated for best electrical contact and freedom from corrosion.

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Adjustable Orifices For Aircraft Engine Testing

By J. P. GREEN, Mechanical Engineer, Buhy Meter Co.

Adjustable orifices are finding wide application in the engine testing field—with a high standard of accuracy maintained under all conditions and results proved comparable to the air bottle method.

A number of aircraft engine and component manufacturers and testing laboratories are using adjustable orifices to measure true and false in the measurement of substance via flow in the scale range required for air-flow fuel flow airplane tests.

Tests have clearly demonstrated that a predetermined series of settings on a single adjustable orifice could produce results directly comparable with the readings obtained with the air bottle system, and that results obtained could be reproduced from day to day.

The manual adjustable orifice, as shown in Fig. 1, consists essentially of a movable, segmented type valve plate (shown by a very accurately machined operating stem, which is positioned by means of a handwheel).

Every manual adjustable orifice is equipped with a vernier scale, graduated to the nearest 100 of an inch, and permitting an accurate means of making the final setting. In addition, two directly visible position reference scales are provided, one of which is engraved in inches and tenths of inches. The second scale may be scaled directly in terms of air-bottle orifice sizes, or other predetermined settings, to simplify and speed up operating procedure.

Adjustable orifices have been built in four different styles. These include three types of manually operated units, and a remote-controlled air-operated adjustable orifice.

The standard manually-operated adjustable orifice may be installed in a horizontal, vertical, or inclined position, with the stem extending in any direction perpendicular to the line. On some installations the pipe line in which the orifice is installed either runs below the flow or above the center of the operating stem, or is located within the test cell. In such cases an extension stem type of manually-operated adjustable orifice may be employed.

When an extension of more than 2 ft. is required, a remote manually-operated adjustable orifice, requiring a flow stand operation, as shown in Fig. 2, may be used. The handwheel and its independent element whose sole func-

tion is to transmit its rotation to the handwheel at operating end on the standard orifice. It is securely fastened to the flange, wall, or tubing, with the handwheel placed in a location convenient for operation, and it includes the same type of collecting scale, graduated with the same precision as the standard scale of a manually operated unit, permitting remote accurate reading and setting of orifice position.

Given to the fact that the orifice body may be some distance away from the operating stand, and that the orifice horizontal or vertical position of the orifice and the stand may vary slightly due to expansion and contraction of the

jointing and building structure, the two units are connected by a universal joint linkage system. However, since the orifice is positioned solely by the rotation of the operating end, and is not affected by relative horizontal or vertical position changes, proper agreement between orifice position and operating indication is insured.

Every manually operated adjustable orifice is provided with a hand handle to secure the setting against accidental alteration.

When it is desired to provide a remote or very rapid means of changing orifice position, using a pre-arranged series of orifice settings, the remote-controlled air-operated adjustable orifice (shown in Fig. 3) can be employed in a structure. In such instances these pre-selected settings may correspond to air bottle orifice capacities or a series of positions chosen to allow the most accurate read position of the instrument under conditions of capacity.

The air-operated adjustable orifice



Fig. 1. A basic manually-operated adjustable orifice manufactured by Buhy Meter Co. It is of simple design and has a high degree of accuracy.



Fig. 2. This Buhy remote manually-operated adjustable orifice employs a flow stand operator and is used when an extension of more than 2 ft. is necessary.

utilizes a cylinder with a series of steps at the outlet. The outlet steps are extended and retracted, and the outlet position is altered by means of a piston cylinder and operating valve directly joined to the operator's control panel. Any number of pre-adjusted positions up to ten are available on most standard units, and the individual steps are individually adjustable for making minor changes.

An interlock system ensures proper correspondence between the position indicated by the position selector valve in service and that of the outlet, the preventing improper outlet operation by engaging the following simple operating sequence:

1. Turn the operating valve to its "reset" position.
2. Turn the position selector clockwise to the new outlet position desired.
3. Return the operating valve to its "operating" position.

Tests reveal that a complete change from any one position to another can be made in less than one second.

All bolts in the outlet superstructure are plates and rivets, as well as all bolts which clamp the individual steps in position, are provided with wire rods to prevent loosening by vibration and shocks.

In Fig. 2 it will be noted that a fixed outlet is provided at the bottom of the adjustable outlet body. This outlet is clamped with the rod which corresponds to the proper outlet position at some predetermined point, and by simply removing the plug and inserting a depth gage, it is always possible to check the agreement between actual outlet position and the scale reading or stop setting.

Adjustable outlets are suitable for making flow measurements over an exceptionally wide range, and the proper selection of size they will accurately measure the flow over more than a 150-

to 1 range, employing a single nozzle or orifice meter, without going below 10 percent of scale on a flow basis at any time. Thus, they are not only suited to producing excellent engine or carburetor tests, but are likewise excellently adapted to experimental tests embracing a very wide flow range.

They can be operated under all conditions of temperature and pressure and for this reason can be used in situations where conditions involving altitude are desired, as where tests are to be made under very low or high temperatures.

In the general engine testing field, most applications thus far have been for engine test cell installations and for the measurement of air in aircraft combustion test cells. However, the use of an adjustable outlet is by no means limited to the measurement of the flow of air, since a number of units are being employed for steam and water flow measurements where a wide range is necessary.

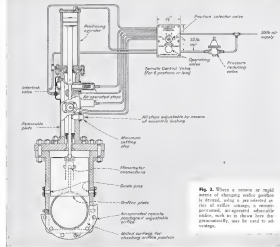
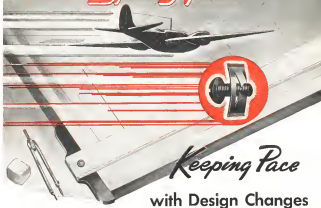


Fig. 2. Where a means of rigid means of changing outlet position is desired, using a preselected unit of outlet capacity, a non-adjustable, an approved, adjustable outlet, such as is shown here, the precisionally, may be used to advantage.

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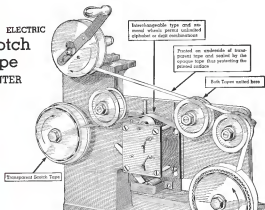
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Spanking down on rough water slivers a plane from nose to tail—even the pilot clamps his teeth to keep from biting something! Think what this does to its control system. Think of the whip and strain on flaps, elevators and rudder. They can't "give", can't dull. Outside of the engine, controls are the "guts" of a plane. They've got to take it, and remain responsive and wobble-proof through countless rough, wet and salty landings.

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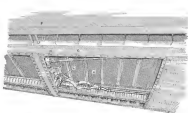
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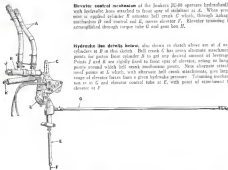
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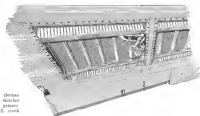


SKETCH BOOK
OF DESIGN DETAIL

Elevator control mechanism of the Lockheed DC-48 operates hydraulically with hydraulic lines attached to front spar of stabilizer at A. When pressure is applied cylinder B contracts bell crank C which, through linkage mechanism D and control rod E, moves elevator F. Elevator trimming is accomplished through torque tube G and gear box H.



Hydraulic line details shown also shows in sketch above are at A and cylinder at B in this sketch. Bell crank C has three alternate attachment points for piston from cylinder B to get any desired amount of leverage. Points D and E are rigidly fixed to front spar of stabilizer, acting as hinge points around which bell crank mechanism pivots. New elevator stabilizer and gear at H, which, with three-way bell crank attachments, give large range of elevator travel from a given hydraulic pressure. Trimming mechanism is at G and elevator control tube at F, with point of attachment to elevator at F.



Front-view sketch of elevator control detailed as sketches show gives additional perspective view of the bell crank mechanism linkage.



powers the . . .

Interstate L-6, newest AAF Liaison Plane

It is significant that the Army Air Forces should have chosen Franklin power for its newest observation and liaison plane, the Interstate L-6. Now in quantity production, this plane is an entirely new design with many advanced features . . . including a light plane engine which has satisfactorily completed an AN (Army-Navy)

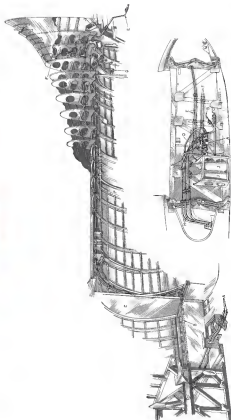
service test without reservation . . . Franklin aircraft engine model 4ACG-199-1B3.

When the war has been won, Franklin engines will again be available for commercial and private-owner planes, "paddy" "Franklins", . . . and get the best in aircraft power for your post-war ship.



AIRCOOLED MOTORS CORP.
Syracuse, N. Y.

SKETCH BOOK OF DESIGN DETAIL



Illustration, together with part of the explanatory notes, of the Interstate L-6 liaison plane, showing the engine, the fuselage, the wings, the tail, and the landing gear. The engine is a Franklin 4ACG-199-1B3, a light plane engine which has satisfactorily completed an AN (Army-Navy) service test without reservation. The fuselage is a new design with many advanced features, including a light plane engine which has satisfactorily completed an AN (Army-Navy) service test without reservation. The wings are a new design with many advanced features, including a light plane engine which has satisfactorily completed an AN (Army-Navy) service test without reservation. The tail is a new design with many advanced features, including a light plane engine which has satisfactorily completed an AN (Army-Navy) service test without reservation.

Shown here are details of the landing installation of the Interstate L-6 liaison plane, showing the engine, the fuselage, the wings, the tail, and the landing gear. The engine is a Franklin 4ACG-199-1B3, a light plane engine which has satisfactorily completed an AN (Army-Navy) service test without reservation. The fuselage is a new design with many advanced features, including a light plane engine which has satisfactorily completed an AN (Army-Navy) service test without reservation. The wings are a new design with many advanced features, including a light plane engine which has satisfactorily completed an AN (Army-Navy) service test without reservation. The tail is a new design with many advanced features, including a light plane engine which has satisfactorily completed an AN (Army-Navy) service test without reservation.

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Ryan supplies the exhaust systems. And they're good—they have to be good to meet exhaust system conditions of Arctic wastes or scorching jungles. So, wherever the Army military planes equipped with Ryan exhaust manifolds pass in their flight, maintenance men have learned to know and appreciate that Ryan Builds Well.



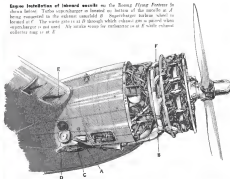
TODAY'S NETWORK of world air routes will tomorrow become pathways over which you may fly. When that day comes, remember your trip will be made in greater speed, safety and comfort because Ryan Builds Well!

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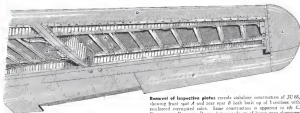
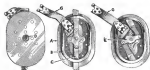
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Ryan Products: Army P-26, Wing H-1, Army P-35, Major Sub-Assemblies and Exhaust System for America's Best Integrated Aircraft

Engine installation of exhaust manifold on the Boeing Flying Fortress is shown below. Turbo supercharger is located on bottom of the manifold at A being supported by the exhaust manifold B. Supercharger turbine wheel is located at C. The waste gate is at D through which exhaust gas is passed when supercharger is not used. Air intake duct for turbocharger is at E while exhaust collector ring is at F.

SKETCH BOOK
OF DESIGN DETAIL



Inspection plates on the J-2000 are used mainly for inspection of construction. Plate A is an exhaust plate for looking mechanism B which also allows access to looking mechanism C. To remove plate a screwdriver is inserted in a hole D opposite side of pin on sleeve in outer flange and turned. This screw counter pin E about 30 degrees, thereby rotating looking pin F. Plate can then be removed, but not detached from plate because of strap G which is attached to both ends.



Removal of inspection plates reveals exclusive construction of J-2000, showing front and rear views. Both built up of 1/2 inch plate with reinforced corrugated sides. Same construction is apparent in side C. Note section D is not a flange, but is made up of heavy gear shoulders allow for strengthening against stresses. Tip E is readily removable, sleeve J is metal riveted. Elevator control mechanism is at G.

The light in a pilot's eyes

THERE'S something about a perfectly performing aircraft engine that makes a pilot's eyes shine. Unconsciously he is probably reflecting the confidence he places in it.

He undoubtedly does not think of its marvellously ingenious construction, the vital roles played by hundreds of precision parts each with its own specific job to do. No, to him it's one single mechanical marvel, with a distinct personality, which he has learned to know and respect because he has found it dependable in situations involving life or death.

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AVIATION
ENGINEERING
DATA BOOK

SHEET NUMBER D-70
CLASSIFICATION Design—Materials
SUB CLASSIFICATION Synthetics

Hycar Synthetic Rubber

THIS material, a butadiene synthetic produced by the Hycar Chemical Co., Alton, Ill., differs from Buna S (butadiene plus styrene) and from Buna N (butadiene plus acrylonitrile). Properties of each type may be varied widely by changes in compounding and processing.

General Physical Properties: Weight—Specific gravity of uncompounded Hycar is 1.18, as compared to 1.93 for natural rubber.

Color—Black compounds give best physical properties due to carbon black reinforcement. Light colored stocks can be obtained, but they do not have quite as good physical properties.

Odor and Taste—None. Special compounds are practically odorless and tasteless.

Hardness—Compounds can be produced with a Shore A durometer range from 33 to 100 (Ebonite).

Coefficient of expansion—0.00043 to 0.00055 per in. per deg. F.

Electrical properties—Compounds having high insulation properties and a volume resistivity at 65 deg. F. of 1×10^{11} as compared to 1×10^6 for natural rubber can be produced as well as compounds with resistivity as low as, or lower than, 300 ohm-cm. cube. This property is useful in applications involving arrestment of static electricity.

Blows—Compounds are free from sulphur blooms. A slight bloom occurs on some compounds due to anti-oxidant, accelerant chemicals, or peroxide.

Tensile Strength: Ultimate tensile strength as much as 4,500 lb. per sq. in. can be obtained by proper compounding and vulcanization. Tensile strength tests of typical compounds are shown herewith in Table I. The results are approximately the same as similarly compounded natural rubber stocks, except that pure gum compounds have very low tensile strength and are of little commercial use.

Elasticity or Retard: This property is generally low. Its synthetic equals natural rubber in these qualities. The capacity to recover from flexion resulting from either tension or compression after an interval of time, however, compares favorably with natural rubber compounds. This property is known as permanent set and is considered of more importance than rebound ability of those in shock energy impact. It also describes its vibration dampening service. This life is comparable in many instances to that

of natural rubber. No exact statement can be made to cover this property.

Elongation: This covers about the same range as that of natural rubber compounds, as Table I shows.

Heat Resistance: of the best compounds is somewhat inferior to that of the best compounds of natural rubber.

Abrasive Resistance: Under normal conditions, shows resistance to about 30 percent better than natural rubber. At high temperatures and in the presence of oils, Hycar is considerably superior to natural rubber and constitutes one of its most useful properties in mechanical applications.

Heat Resistance: Ordinary compounds have excellent heat resistance. However, special compounds have been designed specifically for heat resistance. Maximum temperatures depend upon condition of exposure such as continuous or intermittent exposure, whether stationary or exposed to dry air or steam, and whether

TEST	TYPICAL VULCANIZED COMPOUNDS				
	1	2	3	4	5
Shore durometer hardness	33	50	65	75	100
Modulus, 100% elongation	100	150	200	250	300
Modulus at 25% elongation	100	150	200	250	300
Modulus at 100% elongation	100	150	200	250	300
Modulus at 200% elongation	100	150	200	250	300
Modulus at 300% elongation	100	150	200	250	300
Modulus at 400% elongation	100	150	200	250	300
Modulus at 500% elongation	100	150	200	250	300
Modulus at 600% elongation	100	150	200	250	300
Modulus at 700% elongation	100	150	200	250	300
Modulus at 800% elongation	100	150	200	250	300
Modulus at 900% elongation	100	150	200	250	300
Modulus at 1000% elongation	100	150	200	250	300
Modulus at 1200% elongation	100	150	200	250	300
Modulus at 1400% elongation	100	150	200	250	300
Modulus at 1600% elongation	100	150	200	250	300
Modulus at 1800% elongation	100	150	200	250	300
Modulus at 2000% elongation	100	150	200	250	300
Modulus at 2200% elongation	100	150	200	250	300
Modulus at 2400% elongation	100	150	200	250	300
Modulus at 2600% elongation	100	150	200	250	300
Modulus at 2800% elongation	100	150	200	250	300
Modulus at 3000% elongation	100	150	200	250	300
Modulus at 3200% elongation	100	150	200	250	300
Modulus at 3400% elongation	100	150	200	250	300
Modulus at 3600% elongation	100	150	200	250	300
Modulus at 3800% elongation	100	150	200	250	300
Modulus at 4000% elongation	100	150	200	250	300
Modulus at 4200% elongation	100	150	200	250	300
Modulus at 4400% elongation	100	150	200	250	300
Modulus at 4600% elongation	100	150	200	250	300
Modulus at 4800% elongation	100	150	200	250	300
Modulus at 5000% elongation	100	150	200	250	300
Modulus at 5200% elongation	100	150	200	250	300
Modulus at 5400% elongation	100	150	200	250	300
Modulus at 5600% elongation	100	150	200	250	300
Modulus at 5800% elongation	100	150	200	250	300
Modulus at 6000% elongation	100	150	200	250	300
Modulus at 6200% elongation	100	150	200	250	300
Modulus at 6400% elongation	100	150	200	250	300
Modulus at 6600% elongation	100	150	200	250	300
Modulus at 6800% elongation	100	150	200	250	300
Modulus at 7000% elongation	100	150	200	250	300
Modulus at 7200% elongation	100	150	200	250	300
Modulus at 7400% elongation	100	150	200	250	300
Modulus at 7600% elongation	100	150	200	250	300
Modulus at 7800% elongation	100	150	200	250	300
Modulus at 8000% elongation	100	150	200	250	300
Modulus at 8200% elongation	100	150	200	250	300
Modulus at 8400% elongation	100	150	200	250	300
Modulus at 8600% elongation	100	150	200	250	300
Modulus at 8800% elongation	100	150	200	250	300
Modulus at 9000% elongation	100	150	200	250	300
Modulus at 9200% elongation	100	150	200	250	300
Modulus at 9400% elongation	100	150	200	250	300
Modulus at 9600% elongation	100	150	200	250	300
Modulus at 9800% elongation	100	150	200	250	300
Modulus at 10000% elongation	100	150	200	250	300

Review of Patents

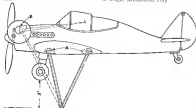
By A. HARRY CROWELL

Registered Patent Lawyer

Followers are digest of some of the more significant recent patents on all those developments granted by the U. S. Patent Office. Mr. Crowell will be glad to furnish readers information, without charge or obligation, on approximate cost and procedure in applying for patents and trademark registrations. Address inquiries to him, care *Aeronautics*, 388 W. 42nd St., New York. Printed copies of any of the patents listed below are obtainable at half cost directly from U. S. Patent Office, Washington.

Cord Assembly for Parachutes is important in aerial law attachments to parachutists. It consists of a means of allowing member to which the ends of a number of cords may be connected and a means connecting member having a passage through which each cord may pass. The passages are evenly spaced about the axis of the connecting member. —3,215,245, filed Nov. 15, '38, issued Feb. 6, '40, D. T. Fisher, E. J. Green, and L. L. Latham, assignors to Glue Corp. of America.

Flight Indicator The attitude and position of the aircraft is indicated on this instrument by means of a dial by reflection of beams of light from surfaces mounted for horizontal movement and remaining perpendicular to gravity lines and re-adjusted before using on the machine. This device can be made to indicate the aircraft's roll, yaw, pitch, and altitude, and is especially advantageous in blind flying. —3,215,246, filed May 8, '38, issued Feb. 6, '40, E. W. Lemley, assignor to Throckmold, Ltd.



For Night Landings this device, now reported in use, indicates where plane wheels are on a predetermined distance above the ground. Light is reflected in way so that in horizontal position the beam is directed down. Beam can be held on or off when plane reaches altitude of about 6 to 10 ft., beam is mounted so as to reflect two spots of light into pilot's line of vision. The spot marks out one another in plane descends and indicates one where it reaches about 5 ft., thus providing positive indication of altitude and reducing danger and danger of misjudgment. —3,215,247, filed Jan. 20, '38, issued Apr. 20, '40, Charles Alder, Jr.

Aircraft Cable arranged as individual spools for drawing are provided with horns. The upper horn occupies a thereby also furnished with a female cable latching horn in which it may sit, even though the corresponding lower horn is made up. —3,215,252, filed Sept. 6, '38, issued Feb. 6, '40, E. F. Bertram, assignor to Douglas Aircraft Co., Inc.

Water Recovery Unit for ships. These units are used to collect and recover water in confined cooling and condensing systems are installed in steamship water shell of pumps which has a propeller at the front and end openings through which air is forced into and through cooling coils. —3,215,257, filed Nov. 22, '38, issued Feb. 6, '40, L. Durr, vented in Allen Property Corporation.

Refrigerant Engine Mount enables slats, like arranged so that there are three cylindrical vanes along which the spring coils are different. Varying rates result from design of members which carry slats. —3,215,258, filed Nov. 21, '39, issued Feb. 6, '40, E. S. Taylor, assignor to Wright Aeronautical Corp.

Internal Combustion Engine is reported extremely light in weight. Of horizontal opposed cylinder type, it is designed to be easily dismantled for repair and maintenance and is arranged for mounting in front portion of fuselage. It is located in a novel lubricating system for rod ends in order to reduce wear and to give proper ventilation. Cylinders are interlocking and cylinder and crank case bearing parts are two complementary members. —3,215,259, filed June 10, '38, issued Feb. 16, '40, C. E. Welton, assignor to The Aviation Corp.

Engine Design has parts of wings acting as floats. There are no other supporting floats to increase weight and air resistance. A wingtip, the wings are connected to fuselage by means of extension and curve downwards until they touch water, then they rise up and outward so that front view of supporting surfaces resembles a "W". —3,215,261, filed Nov. 18, '38, issued Feb. 16, '40, C. D. Dornier, vented in Allen Property Corporation.

Wing Mounting for rotary wing aircraft is an adaptation of camshaft design to a motor which may be power driven or hand driven. It employs a second cam shaft, instead of other cam shafts, which are substantially parallel to other shafts. —3,215,262, filed Sept. 20, '38, issued Feb. 16, '40, E. F. Plummer, assignor to Avicopter Co. of America.

Wing Rotating Device calls for wind-driven vanes on airplane landing wheels to start wheels in motion before they touch ground. Rotating downward of vanes reduces tire wear. Vanes also direct part of wind into brake mechanism to cool it. —3,215,263, filed Apr. 18, '40, issued Feb. 23, '42, A. Daboltz.

Windshield Wiper and Glass is especially adapted for curved airplane windshields. It is arranged through high efficiency jets with other accessories to prevent a vacuum. Tire arrangement for jets provides them in operation. —3,215,267, filed Aug. 29, '40, issued Feb. 23, '42, H. N. Patterson, assignor to Patterson Industries.

New Aircraft Propeller has blade coated with a plastic material at its leading edge. A protective strip is placed over and bonded directly to plastic without any intermediary fasteners, such as nuts, rivets, etc. —3,215,268, filed April 20, '41, issued Feb. 23, '42, M. M. Schwartz, assignor to Schwartz Bros.

Variable Pitch Airplane. Aim of this design is production of propeller of constant value through variation of pitch of blades. A balance is established between twisting moments in blades, made fast by semi-rigid means, and torque transmitted through a propeller hub, or from a governor controlled mechanism, which controls of pneumatic or hydraulic pressure against the twisting moment. —3,215,270, filed Aug. 12, '38, issued Mar. 15, '40, G. A. Johnson, assignor to Algonquin Engineering Co., Ltd. (Continued on page 160)



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IS SURE RAISING HELL

Remember the Jones boy in your own backyard?

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side the U. S. S. Pennsylvania near San Diego—and in November 12, 1912, when the first ship catapult launching of an airplane was made.

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SUBCONTRACTORS SECTION

Conversion of existing equipment to accept related functions has been the key note of subcontracting success. This article trying machine is now used to produce short sections of reduced diameter. The machine is designed to reflect only the required distance.

Subcontracting by a Tube Mill

By D. E. LUKENS, Seagull Tube Co.

Conversion of existing equipment to suit a variety of operations has relieved the bottleneck in steel machining for this producer, innovations in production methods have made possible further adaptation and expansion, utilizing available machinery in many small shops for final trim.

To date, the company has developed a number of subcontractors who are performing varied operations, including machining, swaging, heat treating, strengthening, cutting, annealing, plating, finishing, bending, and slitting, and grinding. Through the medium one of these many services, the company has been successful in greatly expanding

its own production as well as performing an additional service to customers and relieving facilities in crowded areas.

Of equal importance, it has been possible through taking advantage of the local facilities to develop and produce many special tubular parts for aircraft, giving a better weight strength ratio. This is especially true for tapered and heavy end tubes, some of which are discontinued.

SEAGULL was confronted with greatly increased demands for tubing, particularly aircraft tubing, beginning in the fall of '34, necessitating round-the-clock operation before and after of that year. Until this time, production had been primarily devoted to that of straight tubing. We now began receiving requests to produce more tapered and non-tapered parts to aid in the relief of our customers' fabricating and machining facilities.

This unexpected change in customer requirements caused an entirely new production problem. We had no facilities for such operations. For where, our facilities were not sufficient. This situation then necessitated immediate investigation of possible subcontracting facilities in the Philadelphia-Scranton-Scranton Bridgeport area.



Reducing end diameters on heavy sections by turning and the method of drawing methods formerly employed. Here, one piece is being prepared while the rest is turned.



Strengthening operations on heavy welded sections require hydraulic presses up to 50-ton capacity. This particular part must be strengthened to within 50% of full reinforcing strength.

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milicity with Army, Navy and other Government inspection requirements; (7) Sound, alert management—with demonstrated capacity for setting up production plans on design for parts and sub-assemblies.

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flexible machining does not always require space, and it has been found that whenever equipment and personnel could be brought along and spread of work is accomplished on a variable speed machine accompanying an automobile gear shift.

SUBCONTRACTORS SECTION

different and much more difficult than with. The problem of maintaining hard alloy, steel and maintaining surface finish and accurate dimension requires special care and tools. It is therefore necessary to develop working stages of unusual dependability. Machine operators and toolmen must be properly educated so as to insure that parts are efficiently produced to the close tolerances required.

Considerable difficulty was experienced in developing satisfactory controls which had the flexibility and manpower necessary to meet the required schedule. In the early stages, we studied hard instances of poor work and excessive rejections, but with patient working out and close contact and control on the part of our inspection department, we now have several dependable and satisfactory shops.

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(Turn to page 337)



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Instrument Approach By Radio Direction Finder

Part II

By C. H. McINTOSH, System Chief Researcher, American Airlines

Full use of navigational possibilities of radio loop without depending on directional beam is clearly defined in this section of this timely series. Approach technique under high wind conditions and field approach without heading are explained.

THIS COURSE is as well provided with radio beam arrays that transmit radio waves from a radio station to a ship or aircraft as it is with a directional beam radio station. It is well to know the full capabilities of the loop for this purpose, for in today's navigation equipment, pilots are more likely to encounter the problem of an existing or non-directional station. A certain amount of practice and a preliminary plot of procedure are required.

In Part I (page 224, *Max Airpower*) heading procedure for low to moderate wind conditions were discussed. In Part II, presented here, the more difficult problem of approach in high winds is explained, together with a plan for approaching under moderate winds without going through a heading procedure.

High Wind Conditions

The basic process always explains a relatively simple and sure in navigation and wind correction are necessary when one is off the ground at which the heading process is flown.

In other words, if an aircraft of 230 mph is subjected to a wind of 60 mph, or there, to give serious difficulty. There three such high winds are

not always troublesome. Fig. 3 shows the worst possible condition in which a 60 mph wind is blowing at 90 deg. to the original heading takes up also showing the radio station. This problem would work out as follows:

1 After making initial approach, a heading of 45 deg. would be assumed for the run, as in previous example. Due to high wind velocity and its angle in relation to the heading, ground track would be severely distorted, as shown by the broken line.

2 The left turn at Position 2 is made and first heading bearing is assumed for reception of the first beacon position. Time necessary given is 2 sec. On the heading, however, a severe drift also exists so that at time first beacon is received, the airplane has drifted very close to the station.

3 State heading is maintained past the first beacon for 5 sec., as planned for normal procedure. During these 5 sec., the continued effect of wind drift places the airplane in a very disadvantageous place, as at Position 3.

4 When a left turn is made to assume second heading bearing, the airplane has already drifted past the position at which second beacon could be received. At this point the pilot should immediately become aware of the situation if he checks position of the sail. In-

stead of heading station ahead of the airplane, he will discover it is behind and that he is past the second beacon position. This should be sufficient to draw to a pilot who is on the alert, for an exceptionally strong wind can often exist.

5 Immediately he should continue with a second heading turn to left and assume third heading bearing. This he will hold until third beacon position is reached.

6 Subsequent steps in this procedure will be shown in Fig. 3, all of which are based upon the same line of reasoning as illustrated in previous examples, as until pilot reaches fifth beacon position.

7 After receiving fifth beacon, he should no longer attempt to fly original heading bearing. From prior evidence he knows that he is drifting too close to the station and will be unable to reach desired position on approach track unless he compensates for wind drift. While the exact amount of drift is not known positively, it may be assumed that at least 25 deg. of drift has existed on first heading bearing in order to produce the results experienced. Therefore, after fifth beacon has been reached, the pilot should alter his airspeed heading not less than 25 deg. into the wind.

8 Once again he will hold this corrected heading for proper time interval, as previously explained, before making final turn for the field. This final turn, however, may need to be a complete 180-deg. turn due to possibility of fifth beacon position in the radio station. By checking position of the radio station continuously with sail after leaving fifth beacon position, it should

be possible to make the station in desired approach track without undue difficulty.

It will be evident from a careful study of Fig. 3 that the main requisite for executing a heading procedure and D/F approach under high wind conditions is good luck, as part of the pilot. This, of course, is the essence of all aviation flying.

Grow Guardedness

While the D/F bearing and approach procedure explained above is simple as procedure as well as theory, its success as a procedure is directly proportional to the manner with which pilot holds and times the headings he elects to fly. Under instrument flight conditions, the desired accuracy in timing is likely to be difficult to achieve, unless some assistance is furnished by a second crew member.

It is suggested, therefore, that the following coordinated crew procedure be set up:

- 1 The captain shall direct in advance of initial crossing of station, the following crew, utilizing assistance crew member of duty.
- 2 First approach track.
- 3 The first heading bearing.
- 4 Second procedure.
- 5 Second altitude.
- 6 Second crew member shall make a surface record of these facts upon a procedure sheet provided for that purpose.
- 7 Captain shall fly the approach throughout the procedure.
- 8 Assisting crew member shall take each heading down and verbally advise the captain when to make a turn and what next heading is to be.
- 9 Assisting crew member shall note on the procedure sheet each heading when completed and time there on that heading.
- 10 Following some such plan as suggested above, heading and approach procedure can be executed with a high de-

gree of precision. Consequently, for errors in heading or timing will also be materially decreased.

An additional suggestion is that pilots who intend to use D/F approach procedures equip themselves with a navigational type light sound step switch of the same type now furnished navigators for checking ground speed by the drift meter. This similarly reduces chances for error that are present if the sound instrument panel clock is used.

Approach Without Heading

It should not be assumed that a bearing procedure is always an interval portion of the D/F instrument approach. Fig. 4 illustrates how an instrument approach can be made with a direction finder without going through a heading procedure. The same radio station may be used in this case as in previous examples will be assumed. A north wind of 40 mph exists.

1 As in previous examples, on an

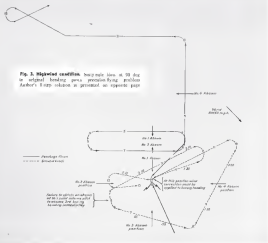


Fig. 3. High wind condition. heading corrections at 90 deg. to original heading plus previous heading problem. After's loop solution is presented on opposite page.



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PLANTS AT MUSKEGON AND SPARTA

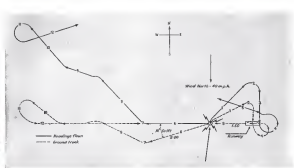


Fig. 4. D.F. instrument approach without bearing procedure.

tail approach is made over the radio station and heading of 45-deg less than tail approach track is taken up for 3½ min at 220 mph, with gear lowered.

2. A turn is made away from the radio station to a heading which is perpendicular to final approach track. In Fig. 4 this will be 280 deg.

3. This heading is maintained until an abeam position is reached.

4. Thereafter a turn is made in the left of approximately 274 deg in order to leave the airplane in line with approach track and headed toward the radio station.

During above maneuvers, ground track is as shown by the broken line in Fig. 4. The moment at which to start the 274-deg left turn will depend upon existing wind conditions. With no wind, elapsed time from completion of the turn at Position 2 and acquisition of the abeam will be very close to 1 min. Under these conditions proceed past the abeam point for 25 sec before starting the turn.

If, however, a tail wind component exists on the heading, the abeam will be reached in less than 1 min. In this event, start the 270-deg left turn immediately. If a head wind component exists, it will take longer than 1 min to reach the abeam position. This turn should be started between 15 and 30 sec past the abeam position.

5. At completion of 270-deg turn, the airplane should be on approach track and headed toward the station. By establishing a roll on the station, the position can be definitely checked

in any event the airplane will not be far from desired position and it is a comparatively simple matter to home on the station from that point. The homing process should be accomplished by offsetting loop to compensate for drift. In the short time allowed, of course, it may not be possible to determine drift accurately, but at least a good indication will be received.

6. Upon passing the station, maintain for 2 min a heading which is the improved or desired approach track. At the end of this time check position of the station by roll signal. If no drift exists, roll pointer will read 0-180 on the approach scale. If, however, a drift exists, the drift angle will be indicated by displacement of the roll to right or left of 180 deg. (That, of course, assumes a double roll pointer. If a single roll pointer is used, amount of drift will be indicated in effect of pointer from zero of the airplane.) In Fig. 4 it will be apparent that the prevailing wind has drifted the airplane to left of desired track. In this case, roll pointer would read 182 deg on the approach scale (showing station to be 18 deg to right of the airplane's tail). Thus an 18-deg drift to the left has been established.

7. If it is now desired to return to intended track line, this can be achieved by altering heading of the airplane 45 deg to the right (heading 335). At the same time offset loop and position 45 deg to right of the aircraft's tail. 8. Observe this new heading until a roll is received with the loop offset

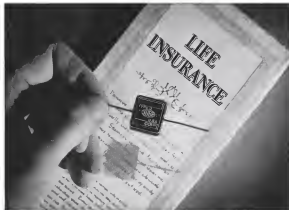
an expected plane. When roll is received, it indicates the airplane has again reached desired approach track.

9. Once upon the desired approach track, return to original heading of 270 deg plus amount of drift. This will be 288 deg. At the same time loop and position should be offset 18 deg to right of the aircraft's tail. The aircraft is now on approach track and on a heading which compensates for drift. This heading may be held for any length of time desirable if some portion of actual approach altitude must be held prior to turning back to the station.

10. After heading 80 deg to the right and maintaining this for approximately 3½ min, or until no. This time should be increased if wind is from the right, or decreased if wind is from the left.

11. At completion of selected elapsed time make a left turn to heading of final approach track. While making this turn, offset loop on the gauges amount equal to the right direction to compensate for drift (the loop has been established in Fig. 4 loop roll should be set 18 deg to right of the nose).

12. While loop offset as explained, fly roll to the desired side maintaining a heading of 35 deg to left of desired approach track. As long as the position of roll and heading bring them within constant, drift is being properly compensated. If roll position must be further to right of the nose, a indicates too much drift correction is being applied. Therefore, decrease drift correction angle. Otherwise of problem to the (Turn to page 328)



NOW AVAILABLE FOR YOUR PRODUCTION REQUIREMENTS!

The first oil-impregnated condenser to be found physically and electrically interchangeable with the majority of mica capacitors used in the by-pass and coupling circuits of radio and radar equipment.

The Tobe Type DP Molded Paper Capacitor has long life built into it through every step of manufacture. Rigid inspections maintain a standard that is exceptionally

high—so high, in fact, that "returns" are almost completely unknown.

For the first time since its introduction we are now in a position to accept immediate orders for Type DP, with proper delivery assurance! They will be filled in order of receipt and we suggest you act promptly. For production samples or further information write TOBE DEUTSCHMANN CORP., CANTON, MASS.

SPECIFICATIONS—TYPE DP CAPACITOR

CAPACITANCE	100 TO 10,000 MICRONS	.001 TO .01 MFD
WORKING VOLTAGE	400 VOLTS DC—each type 1000 volts DC	
SHUNT RESISTANCE	100,000 OHMS TO 1,000,000 OHMS	
WORKING TEMPERATURE RANGE	-55°C TO +105°C	
OPERATING FREQUENCY RANGE	100 CYCLES TO 100,000 CYCLES	
POWER FACTOR	0.0005	

These capacitors meet Army and Navy requirements for maintenance and



Airline Gains Impressive Despite 50% Equipment Cut

AIR TRANSPORT

Air carriers set enviable record in first year of wartime operations, setting new highs in practically every major category, analysis of CAA study reveals covering eight years' progress.

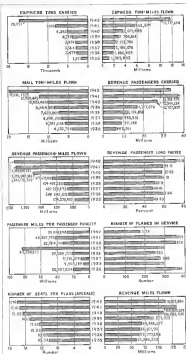
Aircraft's economic analysis showed a separate gain in nearly every major operating category last year—the first in ten—with post-war half the number of aircraft they had in 1941.

Most significant increase was 40% in express (both in ton-miles carried and in passenger load), to passenger load factors and—despite the 50 percent cut in equipment due to government requisitioning—revenue passenger-miles flown.

A study of eight years of domestic air carrier operations just completed by the Civil Aeronautics Authority reveals that last year's gain in express was the greatest both in actual amounts moved and percentage-wise (184.5 percent greater than the previous all-time high set the year before). Total for 1945, the first year covered by the study, was 1,011 tons, at but 9.5 percent of last year's Express ton-miles flown (which was then charged, however, 100 percent—while last year's grossed 60 percent). Although equipment was shipments accounted for most of the increases recorded in both express and mail, the gains also represent some normal growth.

Many people believe that this trend will not go into a serious decline when emergency shipments stop. As a result of severely curtailed shipments just getting "the dust" of rapid air transportation—like it and will soon be met with it. The process will be equipment maintenance, because the latter "hold" are not filled in hauling, with government being loaded with steps to every route.

Because passenger load factor, perhaps the most important indicator for profitable operations, grossed 134.0 percent, bringing a new high of 72.14 percent. While wartime pressure accounted for at the initial decline, in both military and government, a good portion of credit for this more efficient utilization of unit space must be given to the transport companies' material value. (Turn to page 326)





Flying Tin Fish!

FLYING low through a heavy barrage of enemy fire, this Navy torpedo plane has just released its tin fish... dead on the mark. To pull out of danger in an attack like this requires instant maneuverability, backed up by top engine performance.

Thousands of planes in military, Naval and commercial service are getting reliable, economical performance... lubricated and protected with Texaco Aircraft Engine Oil and Texaco Aircraft Greases.

In fact...

More reliable, better maintenance

EL Jany, flying a Texaco plane with any other brand.

So effective have Texaco Lubricants proved that they are definitely preferred in many other important fields, a few of which are listed in the panel.

A Texaco Aviation Engineer will gladly cooperate in the selection of Texaco Aviation Products, available at leading airports in the 48 States. Please the nearest Texaco Distributing point, or write The Texaco Company, 400 New Division, 135 E. 42nd St., New York, N. Y.

THEY PREFER TEXACO

These elementary Diesel locomotives in the U. S. are lubricated with Texaco Diesel with any other brand.

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These locomotives are lubricated with Texaco Diesel with any other brand.

These locomotives are lubricated with Texaco Diesel with any other brand.

These locomotives are lubricated with Texaco Diesel with any other brand.

These locomotives are lubricated with Texaco Diesel with any other brand.

Mass Production Overhaul

By JOHN H. CONNELLY

President, Southwest Aircraft Corp.

Global war which converted aircraft industry from peacetime infant to industrial giant, brought first real large scale aircraft and engine repair. Long the dream of shop managers, production line overhaul is thriving operation at Southwest's Thunderbird Field, and lessons learned will prove valuable guide in setting up postwar shops.

MAINTENANCE

INVENTED, eleven months ago, by the San Antonio Air Depot of the Army Air Forces to establish an overhaul system for training planes, we began operation of the new "line" in September, less than two months later. In the early weeks we obtained an average of one plane and ten engines a day—which is a greater output than the industry could handle in 1940.

In three months the overhaul manœuvre per shop was halved and they are still being reduced. Today's output is a military secret, but it is around three times that of these early weeks, so it has been necessary to enlarge facilities again.

Some phases of the operation differ considerably from what would be routine in peacetime. The AAF, for example, is the lone customer. It furnishes all standard parts and orders almost constant reinspection of the shops passing through the shop. We furnish lubricants, fluids, and such small parts as are found necessary to manufacture in the shop. Allowances should be made for these variations when planning the structure of a normal commercial operation.

We have two sources from which to receive planes for complete overhaul, required by the AAF after 1,500 h. of operation. One source is comprised of the three training fields we operate in for the AAF and one for the AAF. The other is the San Antonio Air Depot, which orders thousands (most of several other overhaul or overhaul shops in the "DDP" (Depot Inspection and Repair).

We also have two sources of engines needing complete overhaul, those from planes, and "spare", the latter shipped in to be overhauled and returned the same way.

Both planes and engines are completely dismantled, cleaned, inspected, repaired, have worn parts replaced, are reassembled and retested. In both assemblies modernization is often selected—older models replacing obsolete equipment and entirely new devices being introduced—which is done as a matter of routine.

Upon arrival, incoming planes are taken to the head of the "line" but



Moving backward from station No. 1 where engine, engine wing section, and fabric were recently loaded over down to the solid frame is ground station of Southwest Aircraft's mass production overhaul and engine overhaul station at Thunderbird Field.

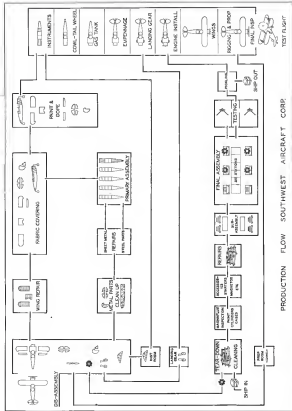


Wings, struts, and empennage panels, shipped at intervals, are cleaned, repaired, and inspected by crews which include women as well as men.



TEXACO Lubricants and Fuels
FOR THE AVIATION INDUSTRY

TUNE IN FRED ALLEN EVERY SUNDAY NIGHTS—CBS • HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY



before entering are given a "job assignment" which is attached to each part if it is removed. These numbers assure each part being kept in its proper place during progress through the several stations it traverses before ultimately going back to the same place in reverse.

Weather permitting—which it generally does the year around here at Phoenix—actual duckwater is done before the ship actually enters the Navajo Nation. Just outside the dome is that station, and all are dressed and wings, capes, and veils, are removed.

Excluded are only the interiors, the plane's propeller, engine, center wing section, tanks on the fusell, and instrument panel are removed and sent to separate departments for complete disassembly, cleaning, inspection, repair, and assembly.

At Station No. 2 of disassembly, covering, wiring, controls, taking, landing gear, and tail wheel are removed, leaving the fuselage merely a skeleton frame.

Explosives have become one thing in America: that way or no way. It is those ruled against us who say there is a problem in the future. We have found that a small, well trained disassembler is more efficient than a large, untrained group. And, as in most aircraft work these days, both women and men can handle these jobs satisfactorily. We have also found that holding to a rigid order of disassembly expedites the work. No deviation from this rule is permitted because it would interfere with efficiency and interrupt the flow of parts to their separate overhaul departments.

It is important in the timing of the entire operation that parts not made to flow from dissimilar groups, after

After disassembly, the fuselage structure, fittings, and all other metal parts are sent to the cleaning department. There they are immersed in vats containing a solvent (Kydol) followed

which then undergo a low-temperature treatment to remove all paint. When these napkins have dried they are spray-painted and sent to primers assembly or to temporary storage in their depot (see).

Statistical analysis was carried out using



Double line of hatches, back to back, over two lines of engine in sub-coupling department. Note that each small pinion means an engine in any desired position for any arrow. These lines mean one station each 35 mi.



On Schedule recently: Yes, railroads are treated on an equal basis with other modes as required. Progression is achieved from station to station. Plans at background are being prepared for test flight.



All planes by United Air Lines

Controlled Maintenance

United Air Lines' routing-control planes ahead for efficient use of today's limited equipment, giving more miles with fewer ships and on even distribution of work.

LIKE MAINTENANCE, as guaranteed by United Air Lines, is based on a system which provides for regular checks up to 725 hr. at one of several major

service stations, with all overhaul and major repair sent to the Winging central overhaul base. The regular refueling and service check is done at all stops. The other checks under 725 hr. are performed at the major service stations at New York, Chicago, and San Francisco.

The such a standardized system it is important to establish a maintenance check which not measure quality and accuracy, reports of all work performed on any ship, so that each station can be kept posted on the condition of every plane.

The source of this information is the trip record, which is made up in duplicate.

MAINTENANCE

Inspection teams flying on wing yards keep tabs on progress of the check. Each item is recorded as done and copies sent to control office in Chicago to be duplicated in Winging and all stations of ship, so that all steps will know what repair work has been done.

also. All work done on any ship for any given trip is noted on the form with outside of numbers needed. Immediately upon completion of trip, the duplicate is sent to the control office at Chicago, where a daily maintenance transcript is made of all trip records received, and these are duplicated at once to all stations at the ship. Four days is the average interval between time of receipt at Chicago and arrival at the other stations.

All maintenance items have unique and unique inspection forms, starting in detail all parts to be checked at each check-interval by line numbers. As work is completed, lines are initialed on the forms, of which an copy is retained for a station record and another sent to the division office to be relayed to, and checked with, the trip record.

SRF another form is used to report on delay or mechanical failure. This is duplicated to Chicago where the engineering office can decide on what action to take. (Turn to page 286)

Checking up at Chicago. Work sheet, designed and built at this base, has a check pen under each item of house door, which Carl Macdonald, Assistant Maintenance Division Chief, is responsible for. This is an important factor in the system.



Yough Carver



PESCO motor-driven Hydraulic Pump for propeller feathering.



A carrier makes ready for its swift, surprise kill. From the first revolution of the plane's Hydraulic propellers everything depends upon precision, split-second performance. The craftsmanship of millions here or home is pitted against the foe. With lives and battles at stake, there cannot be a failure of a single part!

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OPEN
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To our principal customers—the Axis—our doors are always open for business every day, including Sundays and holidays. Offices are conveniently located in all principal jump-off points of the world. Select merchandise available at all times.

AIRCOX COMPANY, Division of



No profits necessary on explosives and hot steel. Drop shipments promptly made on short notice. No order too small or too large. Rates very reasonable. Caution: representatives will call. Inventory includes Japan, Germany and Italy. We deliver!

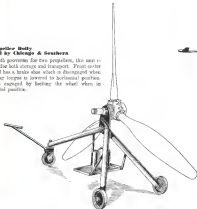
General Offices, 8 So. Madison Ave., Chicago

MAKERS OF THE WORLD'S FINEST PARACHUTE AND BELT HARDWARE

AVIATION'S
MAINTENANCE
NOTEBOOK

Propeller Bolts Used by Chicago & Southern

• With provision for two propellers, the unit is used for both storage and transport. Front carrier wheel has a brake shoe which is disengaged when lowering tongue is lowered to horizontal position. It is engaged by locking the wheel when in vertical position.



Bronze Assembly Stand



• The greater convenience in assembling engine parts sections, this stand will handle other Pratt & Whitney 1800 or Wright 1820 engines, by use of adapters. Sketch at right: A Pratt & Whitney (see) section in place. Any position about horizontal axis can be obtained and held by adjustment of nuts at each end, while height and vertical adjustment is afforded by hand screw below. Sketch at left shows adapter in place which accommodates Wright engine, with addition of drip pan as small parts rack underneath. Stand was designed by E. H. Moore, superintendent of overhaul at Bronze.



Sky Hooks for man-made birds

Just an airplane, of course! But this Denison HydroOLic Test Stand is the newest thing to a "sky hook" in helping man-made birds to keep from faltering in flight.

It makes a quick test—on the ground—of the way spark plugs are going to perform in the air. Faulty plugs are spotted before they cause trouble.

This is only one way Denison equipment is serving aviation. Other HydroOLic Test Stands check the action and control of altimeters, rudders, brakes, landing gear doors and landing gear — the performance of suspension — the feathering action of propellers.

HydroOLic Equipment is also doing vital work in other fields. Its oil-hydraulic control of power and motion is being applied to operations from one end of industry to the other—with greater flexibility and accuracy as the result.

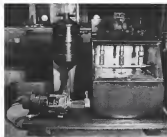
If this suggests an answer to some of your problems, we invite you to take it up now with our engineers.

THE DENISON ENGINEERING CO.
1164 Dublin Rd. Columbus, Ohio



DENISON
EQUIPMENT & APPLIED
Hydraulics

Bearing Washer Used In Pan American Instrument Overhaul

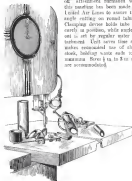


• This washing machine is designed to clean small ball bearings without removing them from the race. Assembled by J. Petro, chief of instrument repair at Pan American's N. Y. base, it comprises a valve having a brass reservoir in the bottom covered by a fine mesh copper screen, a small electric circulating pump, and an automobile oil pump motor for driving the barrel. The three fixtures which hold the bearings to be washed extend at center and clamp down on the bearing by means of springs. Fine spindly bored holes within fixture send beams through the bearing race at an angle insulating continuous circular action to balls, ensuring thorough cleaning. Flood cleaning of each bearing is true cleaning and less efficient.

AVIATION'S
MAINTENANCE
NOTES BOOK

F. M. Tube Cutting Fixture

• In addition to the "butter cut-off" attachment furnished with this machine has been made by United Air Lines to assure true angle cutting on round tubing. Clamping device holds tube securely in position, while index of cut is set by regular meter attachment. Unit saves time and makes recommended use of short stock, holding waste made to a minimum. From 1/4 in. to 3 in. and over accommodated.



Fuel Quantity Test Panel by United

• Designed by United Air Lines instrument department, this test unit component parts of the VAC 3 fuel pipe system, including right and left tests, vents, solenoids, struts, adjustment assemblies, and voltage compensators. Test units are moved up and down by hand against hand stops representing average position of top and bottom of tanks, with indicators observed for indication and conditions of operation. Duplicate equipment is provided on panel for each part to be tested, and two way switches and meter unit to control. Voltmeter indicates either battery input voltage or compressor output voltage, by use of switch. Clamps and connectors provide easy attachment of wires.

A *Star* has been added...



6 months ago the Army-Navy "E" was awarded to Weber's many employees for their loyalty and skill. And now—a star has been added for their continued faithfulness to America's fighting forces. We at Weber guarantee you there will be no rebuffed effort here until this war is won.

WEBER 137 1892

Producers of floor board assemblies, compartment doors, selector tables, bombing doors, rifle racks, radio tables, bombardier seats, plywood wings, control surfaces, hydraulic press stampings, and many other products for your service on land and sea and in the air.



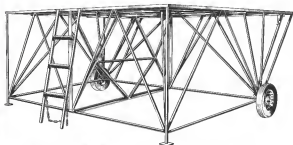
WEBER SHOWCASE & FIXTURE CO. INC.
3700 AVALON BLVD., LOS ANGELES, CALIF.

AVIATION'S
MAINTENANCE
NOTEBOOK



**Portable Tachometer
Test Case Used by TWA**

Incorporating essentially the same units as the shop set-up, this outfit consists of an 1800-rpm. quadrature speed motor driving a variable speed transmission, controlled by handle outside, coupled to a shaft coupler. This assembly indicates speed of a flexible tachometer drive shaft, which is hooked up to tachometer generator or tachometer being tested. An electric generator type tachometer tells operator the approximate speed, while strobe-light indicator indicates rpm, with its plus or minus 1. It will handle full range of speeds required by modern engines. And, moreover, with another tachometer, it is possible to handle all types to be tested.



TWA's Take-Down Work Stand

Similar to many others of the type, disassembling feature of this stand is design which allows it to be taken at half its normal transportation. Special bracing has been provided through middle, so that by removal of sticking bolts stand divides into two convenient sections which can be readily handled by any leveling outfit. When assembled, stand measures 180 in wide, 126 in long, 58 in tall. It is easily placed in position.

Greater Safety at Sea

At Night

A-P PISTOL ROCKET

PATENTS APPLIED FOR
MARK II

RED PARACHUTE FLARE

Minimum Altitude 700 feet
Fired from Standard 1.5
calibre pistol.

By Day

A-P YELLOW CLOUD

PATENTS APPLIED FOR
MARK I

Hand-held, High-Visibility
Smoke Signal, Dispersal
25 Seconds Maximum.

AERIAL PRODUCTS, Inc.

MILITARY PYROTECHNICS
MERRICK, L. I., NEW YORK

Available Only Through
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Gulf Cut-Aid steps up production

of airplane radio covers

20%

-rejections entirely eliminated

Another example of the superior performance of
Gulf's revolutionary new cutting oil

Rejections due to cracking from excessive heat generated in the tapping operation was the bottleneck in the production of aluminum airplane radio covers in a large instrument plant until Gulf Cut-Aid was used as the cutting fluid. With soluble cutting oil, one cover out of every five cracked as the tap cut the threads in a one-inch drilled hole.

With Gulf Cut-Aid, this bottleneck was eliminated immediately! Since adopting Gulf Cut-Aid over 500 covers are tapped without a single cover being cracked. Result: Rejections entirely eliminated, production increased 20%.

In plant after plant, Gulf Cut-Aid is demonstrating its superiority as a cutting fluid for aluminum and other non-ferrous metals.

In addition to its function as the ideal cutting fluid, Gulf Cut-Aid has another important function—it is an effective emulsifier for other cutting oils, regardless of type or viscosity. Blended in varying proportions depending upon the various requirements of the job, the use of Gulf Cut-Aid with other cutting oils makes possible higher cutting speeds and results in improved finish or longer tool life, or both.

Call in a Gulf Service Engineer today and let him demonstrate in your plant—how Gulf Cut-Aid and other Gulf quality cutting oils can help improve your machining practice. Gulf Oil Corporation, Gulf Refining Company, Gulf Building, Pittsburgh, Pennsylvania.

Mail This Coupon Today



Gulf Oil Corporation, Gulf Refining Company
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Please send me, without obligation, a copy of the new revised booklet, "Gulf Cutting Oils" which includes a helpful Machining Guide.

Name

Company

Title

Address



LONG RANGE COVER ...

Pacing our bomber formations over great distances . . . fast enough and powerful enough to smash up any Axis attempt at interception . . . high altitude convoys of long-range Republic P-47 Thunderbolts—potent 2,000 h.p. fighters—extend America's striking power.

REPUBLIC AVIATION

REPUBLIC AVIATION CORPORATION, . . . FARMINGDALE, N. Y. . . EVANSVILLE, INDIANA

AIR MASTERY THROUGH



ENGINEERING EXCELLENCE

Designing Gun Turrets As Integral Part of Aircraft

Part III

Concluding our series on British experience with power-driven gun axles, this revealing article covers developments by Scotland Poul Aircraft, Ltd.

MILITARY

THIS ARMAMENT consists of a paragraph usually appended to the description of an aircraft—but no indication is given of the extensive research and development behind the design of modern power-operated gun turrets or of the continuous efforts to improve their offensive and defensive strength.

Since the early days of the manually operated turret ring, aircraft armament has become a highly specialized branch of engineering and can be considered comparable to such developments as re-

tractable landing gear and the automatic constant speed propeller.

The last war saw the advent of synchronous gear for fixed forward gun, the Bend Sinag, and other hand-operated mountings for open cockpits. Such axles required standard equipment for years—until increasing aircraft speeds made the exposed gunner's task of operating his weapon so difficult it became necessary to provide him with some form of protection and powered assistance



Scotland Poul electro-hydraulic power-driven gun turret designed for installation in tail of Handley Page Halifax four engine bomber. Gun, conforming to general British practice, size of 303 cal.

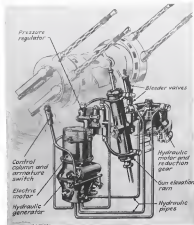


Fig. 1

Among the first to realize the importance of this new development was Scotland Poul, Ltd.—later to become Scotland Poul Aircraft, Ltd.—which introduced the first power-operated turret ever to be fitted on a bomber. This initial turret, designed for installation in the nose of the Overstrand twin engine bomber, was operated by compressed air and housed a single Lewis gun.

Compressed air operation, however, had several disadvantages, and the lack of which was supply, resulting in severe limitations of operating periods—periods which had to be followed by somewhat lengthy intervals for recharging air bottles from an engine-driven compressor.

This system was abandoned in favor of an electro-hydraulic system, selected for reasons of compactness and simplicity, with simplicity of control and resistance in addition to operation and installation advantages.

One of the most important features of this design is that the hydraulic system is confined to the rotating portion of

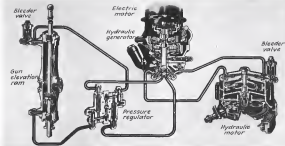


Fig. 2

the turret. This character differentiates it from transmitting high pressure fluid from the power source through continuously rotating joints. In position, the highest pressures are less than the order of 300 psi, but even such applications seldom require more than 100 psi for any length of time.

One consequence of using low pressure is the need for large diameter pipes with associated troubles of space weight, due to the large bend radii required. The Bleed-Back Pump system, however, avoids this trouble, along with others

such as pipe dilation, differential thermal expansion between pipes and fluid, and leakage and fractures caused by vibration. This latter benefit results from the short pipe lengths and the ability to lead them to conform with adjacent structures to which they can be adequately sealed.

The whole of the power units are built into the turret, leads for electric power and other services being taken to a slip-ring unit on the axis of rotation. Installation, therefore, amounts only of lowering the turret into position, lining up, bolting and making electrical con-

nection with its main lines, its external oxygen supply. Thus, all ground tests and adjustments can be made before installation in the aircraft, and a minimum of time is required to mount and replace a damaged turret.

An outstanding operational advantage is that power is used only when required, and there is no appreciable difference in speeds either up or down wind. The turret control handle incorporates a grip lever or "lead man's handle" which, when depressed, supplies the electric motor. Since this operation is inherently performed only when the gunner wants

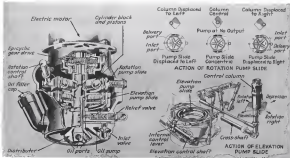


Fig. 3

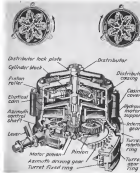


Fig. 4

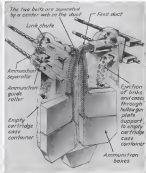


Fig. 5

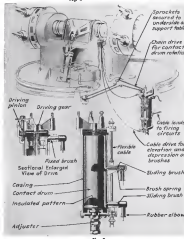


Fig. 6

to put the turret in operation, no power is consumed when the turret is idle. A typical power control system is shown in Fig. 6.

The hydraulic generator incorporates relief valves, set to a blow-off pressure which is full output from the generator less its power in that obtainable from the electric motor. Thus, in operation, no danger of either the electric motor or the hydraulic generator being overloaded. Movement of the control handle against the generator piston, the power output being proportional to:

1. Stroke imparted, which governs the speed of the turret movement.

2. Pressure built up in the hydraulic system (up to a maximum blow-off pressure), determined by the external resistance to turret movement.

It may then be seen that for any turret speed the power output from the hydraulic generator, and consequently power input into the electric motor, is a function of turret speed and of the pressure required to overcome external resistance to turret movement at any instant. This is limited, of course, to the maximum determined by the setting of the blow-off valves, and the speed of the turret is virtually independent of turret movement speed or direction.

While it is impossible to give a full account description of the whole range of turret designs by Bleed-Back Pump, there are features associated with the various types which are of interest.

A—shown in Fig. 2, the hydraulic

FLYING EQUIPMENT



ONE HUNDRED AND TWENTY DAYS from the beginning of preliminary design to delivery of the first plane—specifically designed for quantity production. This was the record established by North American Aviation on its P-51 Mustang.

and a dive bomber version has already gone into production, designs and construction details have just been released.

knowledge passed to that time by the RAF, the AAF, and the company. The commission originally asked that North American build a fighter type already in production, but J. L. Simons, NAA vice-president, told his members on the new craft, which didn't yet exist:

Out where the "fighting herd" becomes grim reality instead of a gift phrase, *E-L* adds an answering bit "Walkin-Talkin'" that serves as the voice and ears of our advanced forces.

It's a marvelously efficient two-way radio, of course. But the Signal Corps knew that it wouldn't be the useful, reliable instrument it is, unless it had a power supply that would keep it operating, under all conditions . . . whether in the destructive heat and gulf of the desert, the paralyzing winter cold, or the corrosive humidity of the jungle.

Such a power supply did not exist until Elctronix's engineers designed a special, high-voltage vibrator power supply, combined with storage battery, in a single, interlockable, light and compact unit.

Behind this and other E-E power supply achievements are years of intensive development of the technique of oscillator-type power supplies, and the most extensive research anywhere in power supply circuits. They have not only produced amazing advances for many military purposes, but creative prehistoric benefits for products of power.

Whether electric current must be changed, in voltage, frequency or type—for use or power—E-Z Vibrator Converters will give the same outstanding service that has made them out for battle duty today.



Lower limbs along red-orange-buff, tan with orange centers to margins of "white" tubercles; some squamous papillae/orange & buff. Outer borders between squamous plate and lower members of the red-orange buff. (20°) Length 10", Weight 40g.

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If you are 16 to 26 years old, inclusive:

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(2) If you have been called for induction, you can't apply directly until after induction in the army, you may apply for Aviation Cadet training after you're drafted into the army.

If you are 17 but not yet 18:
(3) You can go now to your nearest Civilian Training

Board and volunteer to the Air Corps Enlisted Reserve. If you pass physical and mental examination, after you become 18 you'll be assigned for preparatory training leading to appointment as an Aviation Cadet Enlisted under 35 requires parents' or guardians' consent.

If accepted for Aviation Cadet instruction, you will not be able to choose your school, but we hope you may be with us at Ryan. Wherever you are sent, be assured that you will receive the world's finest flight training.

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SCHOOL
OF AERONAUTICS



"Wasting" perfectly good steel causes extra cost. Side panel (left) of fuselage area shown is actually a form the structure comprising two longmen having the form and skin forming the ribs.



reinforced by metal frames. Behind cockpit longmen riveted into area (background) structure is riveted, based on the position, panels go into place (right) when fuselage structure is riveted. "A" cut in center, is riveted.

center, Chief Design Engineer Edgar Johnson studied the work among specialist engineering groups, and worked with design specifications made up from sketches and related calculations.

Despite the time limit, North America was chosen to be a former first wing, even though this type had never been used before. Although the initial design was developed and built around today by the NACA—by which NACA engineers give full credit for research—was used as a basis, the P-51 wing section, as built, perfectly fit the requirements. Of the various, straight, thin wing sections, the area ratio of two panels joined together at the center plane at the fore-edge. Both main and rear spars are forged aluminum alloy sheet construction, with flap and aileron flaps, separate mounted on the main spar. Fore-edge of the wing structure consists of extruded stringers and joined rib with skin covering of aluminum alloy. Fuel tanks are located between the spars on both sides of the structure, with a structural door in the main side of each wing section in each late three modifications and removal.

Next to the famous first wing, North American engineers consider the outstanding factor in the P-51's overall success story to be the fuselage, which has what is believed to be the smoothest cross-sectional area ever put behind an Allison engine.

In keeping with the oval shape of the fuselage, a new idea was tried in the form of a semi-spherical, welded glass window. Weld (and this delighted the engineers, but field engineers) tough as joints, for the curved glass obtained great appearance and

Specifications and Performance Data

Span	37 ft. 1 in.
Length	34 ft. 7 in.
Weight	4,000 lb.
Top speed (1000 ft.)	430 mph
Range	1,500 mi.
Max speed (1000 ft.)	430 mph
Altitude	30,000 ft.

made landing extremely difficult. A conventional window, placed at a 30 degree angle to horizontal line of flight was this installed.

The cockpit itself is under a flush line canopy with an upper and right side section hinged to open for pilot's entrance and exit. Sliding window is built into both side sections, and (Turn to page 30.)



Structural aluminum engine mount, replacing conventional welded steel type, was designed and built to facilitate installation and removal as well as to give ample room for structural and preventive work for field maintenance. Engine cooling controls of fuselage wing and on a detachable panel to provide maximum accessibility for maintenance.



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JAN 1948



Westinghouse

AIRCRAFT MICARTA

MANY AIRCRAFT PARTS such as Fairleads, Control Pulleys and Control Quadrants, are now being made economically from molded Micarta.

Cessna Develops New Cargo Plane

"Loadmaster" makes first flight less than six months after beginning of design; craft is built largely of non-strategic materials.



FLYING EQUIPMENT

Most recent additions to America's civilian growing list of air cargo carriers is Cessna Aircraft Co.'s new Loadmaster, shown here on test flight, which was made less than six months after preliminary design was started. Constructed largely of non-strategic materials, craft was designed for quantity production. Fuselage is of welded cold-rolled sheetmetal, fabric covered, and wings are glass-laminated plywood, also fabric covered. Plane is powered by two 600-hp P & W engines. Performance figures are excellent, but Loadmaster is reported to have especially quick take-off, fast climb, and short landing run.

NEAREST DEVELOPMENT in the rapidly expanding cargo plane field is the Loadmaster, developed by Cessna Aircraft Co., designed for "rapid and relatively inexpensive production," the craft is constructed almost entirely of non-strategic materials.

A high-wing monoplane, the Loadmaster is powered by two 600-hp Pratt & Whitney engines located in nacelles along beneath the wing. Performance data are restricted, but the plane is reported to take off after an unusually short run, its important factor is use of such small in-battle areas where ground facilities may be limited.

With wheels of the landing gear retracted into the engine nacelles and an especially useful feature for flying in the

straitened position. The standard tail wheel is not retractable.

Fuselage is of welded cold-rolled sheetmetal, fabric covered, and wings are glass-laminated plywood, fabric covered, and skin, fabric covered. Basic materials and construction methods are similar to those employed in production of Cessna's true cargo AT-17 Bobcat and Cessna, advanced trainers now being supplied to the Army Air Forces and Royal Canadian Air Force, respectively.

Drum and David Wilson, construction heads of Cessna, point out that the Loadmaster has definite positive characteristics. Quick takeoff, high rate of climb, and short landing run shows promise, they explain, make the craft especially suitable for operation in high

mountainous regions where small fields and rough air make operations difficult. These same characteristics should also enhance the Loadmaster's value in postwar operations in a feeder line cargo carrier.

Newer Typhoon "Unwrapped"

Birmingham, Eng. (Special to AVIA more)—Indicating both a completion of combat experience and working out of defects and production "bugs," details of the new Hawker Typhoon fighter have been released by the British Air Ministry. The Typhoon has been in service with the RAF for some months, but details have been withheld because of secrecy surrounding the No-



Details just released on new Hawker Typhoon fighter show Allied knee another plane in 400 mph class. Now extremely wide based of landing gear which, in appearance, greatly resembles that of Navy's Fieseler Fi 156, with wheelbarrow completely retracting wheels in retracted position. Quarterly large clear canopy, easily climbed, provides better look at outside and engine coolant and oil radiators. Thin duct gives plane radiating appearance, so special markings under wing are added to help distinguish it



from Fieseler Fi 156 during recent action on the European front.

Seen in flight from the side, Typhoon resembles its predecessor, the Hawker Hurricane except that present craft has not built "bomber look" characteristics. Three-quarter size wings large as short broad wings which, because of greater frontal area, appear smaller. Span is 41 ft 7 in., length is 31 ft 13 in., and height is 35 ft 3 in.



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Close-up shows four 20-hp. engines mounted in wings. Alternate engine consists of twelve 200 older engine parts. Turbine is powered by 24-cyl. diesel with "H" section Napier turbo engine officially rated at 2,000 hp. Turbine is needed with exhaust to functional use in turbine maintenance work.

Specifications and Performance Data

Wings	419 7/8
Length	74 1/2 10 1/2
Height	14 1/2 15 1/2
Wing area	400 sq. ft.
Armament	Four 20-mm. machine guns (each 100 rpm)
Engine	Four 20-hp. Napier engines
Engine type	24-cyl. diesel
Engine power	2,000 hp.

Noorduys "Horseman" Serves AAF

Described by U.S. Air Force as the first Canadian-built aircraft to be ordered by the U.S. Army Air Forces. Truly known in the northern hemisphere for its long range and speed, the plane is being delivered with modifications to adapt it to American military requirements.

A high-wing monoplane of 51 ft. 6 in.

Specifications and Performance Data

Wings	41 1/2
Length	54 1/2
Height	14 1/2
Wing area	300 sq. ft.
Armament	Four 20-mm. machine guns
Engine	Two 100-hp. engines
Engine type	24-cyl. diesel
Engine power	2,000 hp.
Engine type	24-cyl. diesel
Engine power	2,000 hp.

propeller engine and the Air Ministry's policy of keeping aircraft on the continent but not with, and it is one of the most powerful mounted in the world but also with the design and engineering modification facilities have been reached.

Officially ranked with a top speed of approximately 300 mph, the plane is significantly reported to have a maximum of about 400. It is powered by a 24-cyl. diesel with "H" section Napier turbo engine, officially rated at 2,000 hp. Recently published reports have listed at 2,000 hp. and some say it is not clear that the latter figure will be reached.

The engine has two main shafts, one at the front, driving a main shaft which has a gear for the propeller reduction gearbox. The main shaft is also to power the Napier turbo engine, but on the new modification the engine has on its side so that exhausts are on the main shaft. This permits greater visibility by burning exhausts back, spark plugs, and other components, also better servicing position than the vertical exhaust arrangement of earlier development.

General appearance of the plane is described briefly, due to a large hull and a small fuselage, and all of the propeller, having large engine (rated 2,000 hp. page 500).

Flying Equipment

in, upon, the result is greatly convertible from wheel to wheel or from operation. The also specified (this can be substituted for which is approximately 50 mph) are a new type developed quickly by Noorduys engineers and AAF representatives to give better results than any road growth. Plans for the U.S. Air Force of the new, produced under license for the Noorduys Turbine, and one of several construction with suitable water facilities.

(Page 11 page 500)



Powered by 516-hp. P & W engine. Noorduys plane has top speed of 370 mph. Modifications made for USAF include replacement of baggage compartment in low line, left side door and fuselage which now show range of approximately 1,200 mi. also engine arrangement. The plane is being delivered with modifications to adapt it to American military requirements.



Noorduys "Horseman," first Canadian-built aircraft to be ordered by U.S. Army Air Force has been assigned to personnel and cargo carrying under designation LC-40. It has six passenger seats which can quickly be converted to make place for up to a cargo carrier. The plane is also said to be converted, later can be substituted for which is approximately 30 mph.

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- 4 DENT-TECH** Made from thin veneers subjected to higher pressure than those used in Ply-Tech—resulting in greater strength properties. Used for use in spars, reinforcing plates, plywood ribs, door plates and dms.
- 5 FIBER-TECH** Consists of veneers used as in Ply-Tech, but impregnated with a plastic resin before assembly, which gives greater dimensional stability. Outstanding for airplane propellers. Also desirable for various die cast sections and electrical housings.
- 6 ADHES-TECH** Consists of veneers with various faces. A trimmed panel, ideal for gluing.
- 7 VENEER-TECH** A veneer-bonded plywood, with either one or both faces in aluminum pressure.
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A-5 Type 1000
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Washington, D.C. 20535

A corolla, elongated, white
divided length; calyces
white, a single central
long, thick, ascending to
divided lobes—of corolla
divided 1/2" thick base
central lobes 1/2" to 1 1/2"
divided length 1/2" up
from diameter 1/2"
thick 1/2"

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⑤

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Under-Secretary Levitt announces that all activities involving war effort will be continued. Leads praises past performances. Lt. Col. Johnson expected to retain post as commanding officer.

Under-Secretary Levitt announces that all activities involving war effort will be continued. Leads praises past performances. Lt. Col. Johnson expected to retain post as commanding officer.

Transfer of Civil Air Patrol from the Office of Civilian Defense to the War Department is the latest order of the President that will have little effect on personnel and operations and is expected to solve the problem of obtaining parts, according to official statements.

CAP will continue to be in command until a launch, of the Armer until the direct control of the commanding general, Army Air Force, immediate transfer of control authority will probably transfer under Lt Col Eric L. Johnson, who was appointed national commander in May 1962. Johnson, although obliged to produce Armer agreements, will not be required to take the soldier's control. It will perform substantially the same tasks as before, according to a letter written by Col Douglas James M. Linn, in Robert A. Linn, assistant secretary of defense for air.

"It is our intention," Mr. Lu stated, "to continue to make use of C&I in every field where the expense is not too heavy, and research is justified on part of the on-off air-traffic, including in that respect the importance of increasing the flying experience of a large number of airlines and stimulating the developing interest in aviation among all our citizens, particularly the younger generation."

The party situation, OGD pointed out, is likely to be substantially reduced in the 1980s in command. Although CMC reform date plans have been granted previously, the Army has virtually abstained most of the profitable supply sources have not been allowed to develop fully (1989).

The War Department, in announcing that no changes were contemplated in the organization of companies, notified

administrative or operating method clarified the parts proposed by saying that the JAF will continue to give CA plans based on Air Force evaluation both operating and maintenance-wise. Administrative and operating costs, and allowances for military personnel will be assumed by the JAF. "Cost of CA is expected to continue

as long as the supply of replacement parts does not threat critical systems from more immediate needs," the law statement said.

And CVP windows have been re-devised at the request of the users.



14. **Col Earl L. Johnson** joined CAP when it was first organized, was appointed as fiscal commander in May, 1942, and will probably continue to hold the post under War Department direction.

activities, which will continue to establish themselves of those activities, whatever the reasons are. No reduction in the extent of the anti-submarine patrol is envisaged at the present time.¹

The regular three-monthly forms of duty on anti-cholera and southern frontier border patrol and two weeks on reserve service, and other measures by the armed forces will be combined along with the flexible policy of allowing the members to choose the service period and recruitment to his own abilities. Forest patrols and industrial reserve service will also be retained.

21) Lando took account of some of the work of the patrol on his anniversary of the shift, which he called the result of the "damned unprecedented so-employment of hunking in a little more than a year in volunteer militia organizations of such value in the Army, that it has been made part of the nation's military establishment."

"The loyalty, courage, and devotion of CAP members, plus a normal civilian role organizational structure, have done the job which many felt could not be done—the working of a group of civics volunteers with civilian commitment to

CIVIL OPERATION AND TRAINING

a large set of statistical models, and effectiveness.

"We are proud of the fact that the decision to transfer CAP to the War Department was not because of any thing CAP had failed to do, but, on the contrary, in recognition of the total and achievement of developing in a little more than 17 months an organization composed of more than 75,000 civilian volunteers, which is of work sufficient value that the Army wants to make it part of its own organization."

Fear Flying Responsible For Most Plane Accidents

"Peanut technique and intelligence still head the list" of causes for more commercial accidents studied during the first half of last year by the Safety Bureau of the CAA, says the Civil Aeronautics Journal. "Peanut plant failure and weather ran third and fourth," it

The trend, however, is downward. There were 370 fewer accidents while there were 50,000 more pilots and students. Improvements were noted in reduction of the number of mishaps resulting from instructional and power plant failures, but the greatest decrease occurred in getting off and entering the ground. Landing accidents were down by 333, accounting for 544 out of a year's total of 1,321; taxing mishaps were next most dangerous, being responsible for 264 accidents.

Over all the eight-day search, a vessel, sinking them first as life takes and second only to fire in damaging planes. Three-quarters of the ships put into again were recovered 8th series. Nearly a third of the pilot involved in collisions lost their lives, are more than half the planes that are lost other things were washed out. Collision ranked third among causes of death chemical failures, were fourth.

Obviously enough, students had more trouble posturing forced landings than adults making them. 9 percent of simulated landings resulted in fatal FIV, while no one died in actual forced descents.



Mr. Gordon, You've Got Something There!

And the curious thing is that he had!

That incredible badwagon is actually the linking link between the Iron Horse and a drag horse. It combined the best features of a locomotive — steam — and a quadruped — legs!

For a horse's legs, brother Gordon reasoned with steering logic, had always been the extremity of efficient hauling power, hence they always would be. So he built mechanical legs for his dream of motive power. . . . The spirited vehicle pranced itself to pieces, and Gordon's dream was ended.

Yet, in 1834, David Gordon had something that might have made mechanical history. It was tractors that he was striving for, never dreaming that the wheel alone would give enough of it to pull his steam-driven carriage. . . . while the regrettable legs on that hybrid hack were remarkably close in principle to the caterpillar-type of traction used today on tanks and tractors!

This story has a modern moral. For every engine and every machine that runs today represents many failures, many successes — and many problems that are still in the process of being solved. And in the solution of those problems lie the great discoveries of the future!

Today, Jones & Lamson engineers and service men are working with leading technical men in virtually every industry and in hundreds of plants, from the largest to the smallest, helping to solve those problems. And behind them is a background of machine tool engineering that spans more than a century of our industrial history — since the days of David Gordon.

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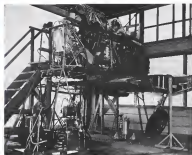
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Since this "cushy rig," derived from an AFMA standard trainer, was limited at South Field Training School No. 4, there have been no body loadings at Folsom Field. Before sailing, RAF cadets get three hours drill and a blooded test in the swim, which requires an 1,000 lb. hydraulic pressure from a 34-p. motor. It was designed by J. E. Winkler at Southwood Army's maintenance shops.

Along the Apron

• The Army's glider pilot training program has been concentrated at one field, South Field Army Flying School, Lubbock, Tex., where classes are being graduated every two weeks. The school is under the command of Col. Monroe B. Olsen.

Under the second Inter-American aviation training program, 30 Latin-American have begun instruction under North American Aviation Co. White House Lake, Minn., and 11 more have begun training for 3,000-hr. student aviator status at Camp Jones School of Aeronautics, Norfolk, N. J. The final 85 of last year's 884 students are due to become commissioned officers by the end of this year.

Reports of 365,000 flying hours yielded a fatal accident have been made for the Private Training Command by two engine malfunctions, 16th Air Assault Troop, California Field, Amund, Fla. and Redstone Army, Thunderbolt Field, Glendale, Ariz. There has not been a fatal accident at Corbin Field since it began operations more than two years ago.

Between 18 and 28, scheduled but not yet scheduled for an imminent training by WTS, can now make applications to be regular Army aviators only.

To prepare young women in engineering aids, United Aircraft has re-

lated Pratt & Whitney aircraft developments at 48 work-study units in mathematics, physics, chemistry, engineering drawing, aerodynamics, and related fields.

Oklahoma state system of higher education has awarded Spartan College, Tulsa, to under an associate in arts degree in aeronautical engineering. J. Edgar Hopkins (University, Oklahoma), and the Texas Instrument Div. of the Minneapolis-Honeywell Corporation, are incorporating in a course in the use of industrial instruments and controls.

On Patrol

• Interpreting WTS identification of front under L-30 on routing planes for maintaining aerial students, UAC reports that "training the CAP is now general official recognition under aviation conditions to be specified in detailed manuals which will reach you through Wing channels. . . . All previous instructions regarding the patrol of CAP aircraft are obsolete, except as pertinent to the A category." The entire CAP plans are protected by retention for parts and special recognition, but when are still being taken to War Training Service.

Endnotes in CAP continue to increase. Searchers flying below 5000 feet may be recognized as flight status brought up to strength within a seven-

CIVIL OPERATION AND TRAINING

this time. Total membership is now over 15,000.

In addition to annual patrol work, New York state flyers undertook 3,300 missions during the past year, according to Wing Commander Stuart G. Webb.

"I do not believe that any group of Americans are making more patrols, emergency, or bushland service than the Civil Air Patrol," said Sen. Bennett Champ Clark of Missouri after hearings on a bill to provide for injury and death benefits. CAP men look on aviation, he said, "have killed just as much in line of duty as men killed in action." Twenty men have died, 37 on over-water flights. Most recent fatality was 2nd Lt. Roy H. Davis, who crashed off Atlantic City, N. J. Men who have the lower unfortunate to be captured by the enemy will be treated as prisoners of war—if the rules of the Hague Convention are observed.

The National Wing has been organized into three quadrants: Washington, Baltimore, and Cumberland areas. Among Wing officers are Maj. Arthur C. Hyde, commander, and Capt. E. J. Deffen, executive officer.

Two planes of 51. Lando Squadron 3 supplied refueling to the recent mission of the GCO, two specialists school, B. Lando, he dropping inside and gas tanks on the Mississippi River levee. Kansas City Squadron 3 has been formed by some 100 employees of American Airlines, Inc.



Membership in the Duck Club, organized by this device was before the last year, has been recorded since dawn. General Patrol flyer who have made several successful landings. This feature was founded by Lt. Col. E. A. Viles, CAP executive officer, whose nephew Lt. Ward Viles was one of the last to get his first flight.

READY AND WAITING FOR
"the plane of the future"



Aircraft engine designers can now start with a clean sheet of paper. They can undertake new investigations. For the first time, they need not compromise their designs according to fuel limitations. The new Houdry Adiabatic Process makes possible a super-aviation fuel so vastly better that engines of current design cannot fully use its capabilities. New designs will have to be created—not only for engines, but for aircraft that can withstand the strain of multiplied power and speed.

Improved Performance for Present Plans

Until these super-aviation fuels are designed and built, this super-fuel will be important principally as a "bleeding agent" by which present aviation gasoline may be saved in quality. Even when used in this manner, it will result in greatly improved performance for aircraft of current design.

A semi-commercial plant is now producing super-aviation gas by the new Houdry Adiabatic Process. Its entire production is reserved for testing by the armed forces and Houdry technicians. For military reasons, full

details of the operation of this plant, and of the process itself, cannot be published. However, inquiries from qualified sources are invited and will be satisfied to whatever extent may be permitted by government authorities.

Houdry Plants Make 90% of America's Catalytically Cracked Aviation Gas

The new Houdry Adiabatic Process is the most recent development of Houdry research in the field of catalytic cracking. Houdry plants last year produced more than 70% of all the catalytically cracked aviation gas in the world. Better gasoline, by the way, than is made by any other "hot cracker" in existence.

Houdry Catalytic Processes and the Thermoflow Catalytic Cracking Process are available to any and all American refiners without restriction, under license arrangements subject to approval by the United States Government.

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*READ MARK — is a valuable feature ability to reproduce any problem, under heat or vibration, during all manner of aircraft tests.



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Type 1001, 1002, 1003, 1004, 1005, 1006, 1007, 1008, 1009, 1010, 1011, 1012, 1013, 1014, 1015, 1016, 1017, 1018, 1019, 1020, 1021, 1022, 1023, 1024, 1025, 1026, 1027, 1028, 1029, 1030, 1031, 1032, 1033, 1034, 1035, 1036, 1037, 1038, 1039, 1040, 1041, 1042, 1043, 1044, 1045, 1046, 1047, 1048, 1049, 1050, 1051, 1052, 1053, 1054, 1055, 1056, 1057, 1058, 1059, 1060, 1061, 1062, 1063, 1064, 1065, 1066, 1067, 1068, 1069, 1070, 1071, 1072, 1073, 1074, 1075, 1076, 1077, 1078, 1079, 1080, 1081, 1082, 1083, 1084, 1085, 1086, 1087, 1088, 1089, 1090, 1091, 1092, 1093, 1094, 1095, 1096, 1097, 1098, 1099, 1100

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5) and "midget" (Series 31) men and with practically any contact arrangement that may be required. Together with hundreds of other Relays and Timers for a wide variety of uses, they are described in 48-page Danco Catalog and Relay Data Copy gladly sent upon request. Please return coupon for connection.

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As with anything else, it pays to buy Relays and Timers from a concern which, for years, has specialized on such production exclusively. Dumco offers relay-timer units a complete line covering almost every quality application. Plus a broad engineering background in relay selection and use. Our engineers will gladly cooperate in solving your problems.

INFORMATION TIPS

Pratt, Pamela 31

In two ballrooms from Esquetering and Research Corp., Riverside, Md., are performed installations of Koro hydraulic stretching process and Koro automatic punching riveting machines. Latter are designed to punch and connect hole and automatically feed and bend rivets.

Lecture 10: The 19th Century 2

Data is being used to power supply, electronics, plating, and refinishing, heating and adjusting hydraulic brags, adjusting electrical gals, and maintaining and aligning systems of ballistics for engineering centers and other users are contained in *Keep Your Letter to Press*, Bulletin N-4 of South Bend Lathe Works, South Bend, Ind.

Thread Cutting Issues3

Photostereograph studies of screw fits loaded by Stakeproof Gittings, show how company's thread-cutting service can be designed to eliminate need for tapping while giving stronger fits. End of screw is slotted off center to prevent cracks or ruts without effect on work.

Geover Systems 2002 11/11/2002 11:11:11 AM 4

<p>Category 5B, 10b, 40b, Category 20b (a, 5b, 10b, various chairs, an upright and also of various other designs, 10b, 10b, representing information, and also chairs of various other designs made in plastic, throughout country.</p>

Briefing Chart [View presentation](#) 4

Richard Laine Panel Co., Brooklyn, is offering wall-on-shaft to foundation apparatus—designed with lettering, dimensioning, indications for standard sections and breaks, and more than 1,000 details.

Standard Delivery 8

Hadley: Louis Arpa Systems, New York. Left: concrete foundations of ports and incinerators; and diagrams of operating principles of low's water-saturated gas flow delivery systems for feeding plants.

Wire Sizers 7

In DeLima 740 & an were rope chains, Western-Hillman Co., Middle, N. J. presents its line of hand- and hydraulic-operated rollers.

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Self-looking 'eyed' and⁸ for thick or

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Products & Practices

Pipe Welding 34

This concise article has been reprinted for distribution by Air Education, New York City, on the Wrecking of Pigeons.

Class and Equipment 16

Uses and properties of re-cast glass for structural construction, insulator enclosures, joint assemblies, and supplies and equipment for glass houses are described in a handbook and in Catalog No. 3 published by Perkins Glass Co., Leasdale, Pa.

Survey Testbank	16
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Dead Cowan 4-sec, 203 page text; published by Dead Science Co., Box Three 10, contains charts and diagrams showing how modernizing has replaced regular working on farms and non-farmers' estate and alien, plastic, wood, rubber, etc. Other sections discuss choice of sex, velocity, and feed growth, also present information on machine tools.

Devergonite, pre-polymer drinkings, and blazings of modified phenolic sheet and aluminum alloy polymers both ball or roller bearings are shown in brochure from General Adhesive Equipment Co., Ashley and Wilkes-Barre, Pa.

Timing released by Atlas Brass Foundry, Los Angeles. Holes often had pieces of finished bronze bushings and porous oil-retaining bearings company carries in stock, also patterns prepared available for cold and solid brass.

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TOOL CHASERS — Milling and Tapered Chasers
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Machine grinding
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Fine grit grinding wheels for producing the high surface finish that greatly lengthens cutting tool life

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Metal bonded diamond wheels for the off-hand grinding of single point cemented carbide tools

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Crystallized vitrified wheels for many roughing operations and for plants doing only a limited amount of carbide grinding

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Mounted Points and Mounted Wheels are available in nearly 200 standard sizes and shapes in several diameters and bonds

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For engineering service and informative technical literature on tool grinding, or any other grinding service, write direct or contact your Norton distributor

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*Use the No. 12 (open) structure wheel for extra heavy stock removal in extra or close of size or both



Why Ozalid clicks with engineers and draftsmen

STUDY THE cross-sectional drawing of an Ozalid Whitoprint Machine. . . It tells much of the story.

Plotting is reduced to two operations—Exposure and Dry Development. . . the liquid holds the plotting mechanism, the drier which for fifty years have been a part of blueprinting are eliminated. SIMPLIFIED PLANTWORKING allows simplified design—and an Ozalid Machine is so compact that it may be installed right in the drafting room where it can be operated by anyone.

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never necessary to redraw any line which remains the same in the new design. You merely make a trace parent print of the original tracing, delete the obsolete lines with a corrector fluid . . . and draw in the new design. It's that easy—as Van Dyke design, no photographic equipment required.

Ozalid Whitoprint Machines are designed for large scale production and occasional print production. Adopt Ozalid . . . and make positive reproductions direct from your engineering drawings, charts, and letters.

WRITE FOR "SIMPLIFIED PLOTTERING." It shows how leading manufacturers save time, labor, and materials with the Ozalid Process; also contains samples of whitoprints having blue, black, and various lines on white backgrounds.



Cross section of Ozalid Model B. For large scale production (up speed 90-dot per minute, direct or two print delivery) most new features.

OZALID PRODUCTS DIVISION

GENERAL ANILINE AND FILM CORPORATION
Johnson City, N. Y.

Illustrated in Aircraft Production, No. 225 by Automotive Bodies Co., Detroit

Metal Parts . . . 49
For color patterned presentation of 1/2 in. Square Co. Columbus, shows first line of small metal parts, including thermal valves, brackets, clips, lifting equipment, valve-chamber parts, drawn at spot drill-

Injection Laboratory . . . 53
Fourteen types of measuring instruments, tools, gages, and optical inspection devices are briefly described as being in use through Baker Co., New York City, in limited budget injection laboratories.

Latest Machine Tools

Mill Converters . . . 51
Designed to be operated by women, line of mill converters made by Tuckwell Mfg. Co., Buffalo, in thirty variations, and finished assemblies are light enough to be moved to new locations where they need only be con-

verted assemblies in five minutes and with change in tools for converting long assemblies and spurs—Anastasia, Erie, Pa.

Milling Machine . . . 52

Model 4 machine tooling with brass tool service is in production by Bessman Corp., Detroit. Unspecialized tool steels are assembled in better surface with tool and is kept under tension by spring mechanism above to avoid axial play in tool when thread shoulders. Table feeds range from 1 to 30 in. per min., and rapid traverse table movement to 500 in. per min. Manual in automatic operation is provided in other direction for traverse and table feeds, and automatic table disposal of cuttings. For special operation, table gear box, provided with disk plate clutch, low-high and low speeds. Starting button safety feature and clutch lever safety lock allow machine to operate only according to specifications for each particular job. Be-fore reaching to clutch lever rate of labor saved when cutting is stopped. But coolant, which may be applied directly to enter through a hole, can be left on. Tool-up control, accessible through keypad cover is base of machine, provides power, and control equipment in

speed to 118-in. (50/60) rpm control and 50-180 lb. air pressure system. Various machine will accommodate holes from 3/32 in. to 3 in., or larger on sheets up to 66 in. wide and 14 in. thick. Operation: Drilled hole is placed over designating point on work, spindle is started automatically by trigger under paper or by manual switch, and then demands to hold the work, followed by revolving cutter, depth being controlled by mill spindle. Color surface protection is made by means of non-revolving mechanism. Then returned valve which sets into cylinder raising holding shoe and spindle, and jet of air blows away chips. Model illustrated has throat deep enough to accommodate upper half of plate saw machine and flat portion of banding edges without necessity of removing them from machine. In other types are available, including models with slotted areas for working on con-



The trend is to warm-setting
PHENOL-RESIN GLUE
for wood spar construction and wood aircraft assembly



ADVANTAGES OF CASCOPHEN LT67:

- Boilproof
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- Permits 1 1/2 hrs. assembly
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• These are the reasons why this unique glue is receiving attention from leading aircraft manufacturers.

Send for Technical Bulletin 184 describing CASCAMITE LT67 in detail. Address—Casein Company of America (Dept. Ad) 350 Madison Avenue, New York, N. Y.

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Phenol resin, Duro resin and Casein glass to meet all aircraft specifications

NEW PRODUCTS

mounted on casted cover on left side. Specifications: Table 20x72 in., maximum length of travel 48 in.; maximum distance of spindle above table 24 in.; maximum cross travel 30 in.; spindle speeds 25 to 1,740 r.p.m.; height 64 in.



For Speedy Handling of All Production and Servicing Operations on All Types of Engines

Shown above are two members from our complete line of airplane engine stands, which includes models for handling all production and servicing operations on all types of engines. The stand on the left is designed for use with interchangeable mounting plates for radial engines. The cylinder stand at the right is designed to handle engine cylinders during manufacturing and servicing operations. Further information on stands for any type of engine will be sent on request.

Staley MANUFACTURING CORPORATION
COLUMBUS, INDIANA, U. S. A.

Rotary Shears..... 53

Made in six sizes, rotary shears produced by KING BEN ENGINEERING WORKS, Chicago, have adjustments for cutting bars, springs, straps, straps, bands, etc., and are 10-in. to 30-in. in length. They cut 1/2 in. to 2 in. of material, and are of hot-treated tool steel, and are chisel through double shears. High-speed shafts are mounted on side.



It has bearings and low-speed bearings. Housing at back of machine is of built-in. It has and specifications are mounted on some. KING BEN ENGINEERING WORKS, 240—Aurora, Ill.

Hydraulic Press..... 54

Operated by motor-driven pump unit which can be installed in another room is hydraulic press K. Hydraulic press, size being manufactured by Hydraulic Machinery, Dayton, Ohio. This unit provides 10, 20, 25, and 100-ton units, which can be adapted to capacities up to 250 tons. Diameter of cylinder and length of stroke have varying ratios depending upon capacity required, instead of operation is provided by four-way valve which automatically cut off when predetermined pressure or capacity is reached. With five sets of heavy cast-iron bolts together by two sets, vertical power cylinder is placed above base plates, which measures 20x20 in. to 30 in. and 100-ton models. With dual power unit, pressure capacity 2500 to 5000.



NEW PRODUCTS

spec. twenty-five to thirty (thirty-five) has 10 in. bore and 8 in. stroke. —Aurora, Ill.

Oil System Cleaner..... 55

For cleaning aircraft of impurities, regulators and valves, Tuna Products, Los Angeles, has produced a special light oil TWA machine (page 21), Max. American and special oiling improvements. Parts to be cleaned are placed in pouring machine which are removed by a motor and run mechanism attached to a 1/2 hp motor. Pumping



mechanism, also attached to motor, pump and valve cleaning valve. Through regulators and valves, while they are being cleaned. The machine also supplies special cleaning compound, (Tuna), which can be contained in 40-oz. measuring in machine. Two die-cast handles are provided to catch particles removed by solution. Depending on condition of oil system parts, several cleaning runs is 1 to 2 in. —Aurora, Ill.

Thread Millers..... 56

Single and general purpose thread milling machines have been newly designed and calculated by H.C. Bartlett Machine Co., Rockford, Ill. Working elements are completely enclosed, as are electrical controls and coolant system, with better heat transfer through doors and plates. These machines are incorporated in both models offered, capacities being 30 in. from square down to 42x28 in. Single purpose model (also called) uses multiple type thread mill for making right or left internal or external threads. Feed rate



Arteries for a Fighting Heart!

REX-FLEX Stainless Steel Flexible Tubing is battle tried and proven—at the heart of the giant motors which power the Boeing Flying Fortress—on equally important applications on many other of our latest, largest and most formidable military aircraft.

In aircraft production the adaptability of **REX-FLEX** for installation facilitates the flow of parts through manufacture to assembly and speeds the co-ordination of major parts into final assembly.

REX-FLEX characteristics of light weight, strength, flexibility, and resistance to corrosion, heat and vibration are solving an ever increasing number of vital problems in aircraft design and construction. Like the accomplishments of the aircraft industry itself, the application developments of **REX-FLEX**, considered impossible mere months ago, are commonplace production line assemblies of Chicago Metal Hose Corporation.

Write for Engineering Recommendations

CHICAGO METAL HOSE CORPORATION

General Office: MAYWOOD, ILLINOIS

Factories: Maywood and Elgin, Ill.



Turntable saves time in welding small assemblies

Information supplied by an Industrial Publication

Several means are being applied industrially to save time and reduce fatigue of welders working on heavy jobs. Positioning tables, rotating rigs and similar devices for handling heavy or bulky assemblies are quite generally used.

One aircraft manufacturer has adopted a similar idea for welders working on small subassemblies. The assemblies are light, and joints are usually quite accessible. But moving the assemblies by hand does occasion some delay.

This is obviated by mounting the work on a small turn table somewhat resembling an old style potter's

wheel. The turn table is quite simple, consisting of two round plates mounted on a common shaft.

The upper plate carries the work, and is located at a convenient height above a work table. The lower plate is a few inches above the shop floor. It is positioned so that the operator's feet rest on it comfortably.

Then, when the operator wishes to move the work, he simply "indexes" the lower table by foot power. The weight of his feet on the plate is, however, sufficient to hold the whole turn table steady while he is welding any particular joint.



is encased with work spindle, and set up in 5 or 10 min. in held in an integrated unit. It is used to clean and polish work by use of ball screw into single or multiple rollers, which have filing adjusted for alignment with barrel hole angle.—*IRONWORK, June, '42.*

Casting Cleaser 57

Model products cleaning machine designed by Airap-Engman Co., Quincy, is equipped with 36 in. "wet mesh



rotary and continuous drum for dust, and overflow to wash, trim, and

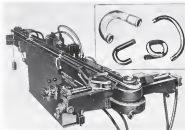
NEW PRODUCTS

• Accessories of new machine tools, shop equipment, and accessories are listed for inclusion in these columns. In writing, emphasize specific industry applications of newly-marketed items in descriptive, and whenever possible, glass-plate photos should be enclosed for illustration. Manufacturers should address New Products Editor, AVIATION, 318 West 42, New York City.

dry, nonflammable, air plane castings, up to 2500 in. Tools and chambers are constructed of 1 in. plate and pumps and motor, are powered by variable voltage. Other features include solution thermometer, and pump without flexible couplings.—*IRONWORK, June, '42.*

Binder Attachment 58

Pace Engineering Co., Ames, Ill., has added patented binder attachment, which provides short radius bends on its line of hot-chamber bending machines. Attachment is separate cylinder through which work mounted and passed. As take advances on work, cylinder applies pressure to its rear end, thus refines tension which results. Leads rollers of lead and after rollers take in collapse. Binder pressure is sustained after take is completed from bending dies, helping to produce it.—*AVIATION, June, '42.*



FENN VISES

The Illustration Tells The Story

GENERATED surfaces both on driving jaw and clamp backing of the Fenn Vise give positive holding security. No possible chance of work slipping with this gripping feature. No shearing stress on clamp belt either—only tensile strain for which it is amply heavy. Note the serrated surfaces. Note that they mesh perfectly—safely—yet can be instantly released for quick adjustment to other work. Note built for holding special jaws quickly adapted for holding work without slipping, no matter what shape.

Good in these instances:

- Airplane Engine Parts
 - Machine Gun Components
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 - Electrical Equipment
 - Tool Making
 - Precision Instruments
 - Special Jaws and Accessories
 - And any small parts production
- Send for Bulletin No. 12

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Climax Molybdenum Company
500 Fifth Avenue • New York City

Shop Equipment & Accessories

Valve Lifter..... 59

Sealed in Polyethylene value billed in
draw (patent). New Britain Machine Co.



New Britain, Conn., reports it can be
hard cold as it may be these days.

for several jobs. But it is short and has closed doors — *Asbury*, June '87.

Cylinder Head 68

Latest addition to line of engine handling equipment made by Motor Rebuilding Specialists, Chicago, is stand for accessible and overhaul of cylinders. Standard model has clamps for holding one cylinder. Available in portable and stationary models, stand has cast



MISSION

Many hundreds of integral Ears, in great numbers of the air, are depending at all times upon the operating efficiency of aircraft radio equipment. Astatic Coaxial Cable Connectors, Multi-contact Plugs and Sockets and Astatic DFN Series Dynamic Microphones . . . used in connection with aircraft radio equipment . . . are manufactured with such precision and accuracy as to insure positive performance under the most adverse wartime conditions. Increased production facilities now enable Astatic to supply these important parts in a larger number of radio manufacturers.

ASTATIC

THE ASTATIC CORPORATION

YOUNGSTOWN, OHIO

NEW PRODUCTS

located in an elevated position (to
avoid the water-soluble barriers,
Fig. 1).

Air Use 61

Heart-tail men and problems for our brilliant youth of 40 are reviewed, at our new of **Head Specialties Co.**, the new **Model 49** (illustrated with head control) can also be found with re-



type of foot control valve. It measures 14(14 1/2) in. long, 4 in. 2 1/2 wide, 1 1/2 deep, and setting procedure starts up in 2 in. large setting 1 1/2 to 1 3/4. Weight 50 lb.—*Interiors, June, 44.*

Letter Tool Post..... 42

Ordinary letters can be turned into postage stamps by application of mail post designed by Marco De Willemaere. There is said to enable anyone to do some mailing, drawing, creating, cutting off, throwing, characterizing, forming etc., at one setting. That can be installed in regular mail post slot.—*Advertiser*, June, 1985.

Chiller Unit 63

Two-stage clothing will be worn in Motor Products Corp., North Chicago, makes 280 Blm per hr. of production.



NEW PRODUCTS

temperature of -70°C . It is rhombohedral with infinite diameter of 15 m and 40-m depth. One end is connected by double rail road cylinder, and whole tank, giving 34 sq ft of pressure-bearing surface and capacity of 40 gal. in 3360-cu in. Output of two-stage compressors and single-stage refrigerators, powered by 1/2-hp. motor, can be controlled from atmosphere to -90°C .
Science, 29, 34

Redwood Plastic.....64



her suggested into various plastic (or elastomer) replacing them from oils made from fired rubber and other thermosetting plastics. Molecular was assigned to **Sholar Mfg. Corp.**, Portland, Ind. Research was conducted by this firm and Pacific Insulation Co., San Francisco, and Institute of Paper Chemistry, Appleton, Wis.—**ANALYST, June 24.**

Index-Ref. Code..... 4

Take their 1987 "development Infra-Red Engineers & Engineers Cleveland, are supplying Modulo in ground down in Italy and within which can be assembled around, I continue to maintain and we have

Speed Working Tools
for Precision Operations

New and Old Workers find SPINTITE the fastest wrench for speedy assembly of small parts.

Standard sizes with hex sockets from 3/16" to 5/8". Kierfed Round and Square Sockets available on special order.

SPINTITE works like a snow shovel.



751 Set in
Leatherette
Egg includes
7 SPINTITES
3 screw drivers
and chuck type
handle

STEVENS WALDEN, INC.

表 10-1 不同地区 VMD 生产函数估计结果

WORCESTER, MASSACHUSETTS, U. S. A.

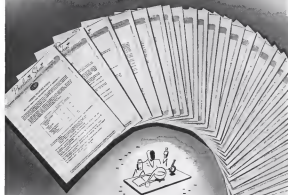
JUST OFF THE PRESS! SEND FOR THESE



PRODUCTS SHEETS

OF U.S. ARMY, NAVY, AND AIR FORCE

Specification Finishes



These Products Sheets will be helpful to you, because they contain complete laboratory, production, and application details on a wide range of U. S. Army, Navy, and Air Force specification finishes which we are prepared to furnish you promptly and in any volume. Send for the entire file today. (Write us your business letterhead, please.) At the same time, request the illustrated folder which describes our modern production facilities. In addition to supplying standard specification materials, we will be happy to place our research laboratory at your service in the development of new and improved formulations in most special finishing problems. You will find us . . . at all times and in all ways . . . a dependable source of supply!

TESTOR CHEMICAL COMPANY, ROCKFORD, ILLINOIS, U.S.A.

NEW PRODUCTS

with reflective and Fiberglas modicum. Sealed time duty are removable, and 250° and lamps are sealed in vacuum with individual particles to better protect from time contamination—*Aircraft Eng.*, 7/5

Swivel Caster 66

Announced by R. E. Fisher Co., sales agent for Ross Mfg. Co., Detroit, is heavy duty all steel swivel caster with



drop forged baseplate and Tuskon thrust bearing mounted king pin. Caster weighs on 3-in. threaded steel bearings—*Aircraft Eng.*, 7/5

Electric Millimeter 67

Model 410 prototype of Radio City Products Co., New York City produces an all-vibrator, millimeter, resonator, capacity meter, ohmmeter, and resistor meter for shop, laboratory, and field work, etc. Measurements are made without magnet inside coil, and a.c. meter are linear with d.c. sensitivity



How to Extend the Life of Your CURTIS AIR COMPRESSORS



• It will pay you to follow these suggestions for proper servicing of your Curtis Compressor. While long life is an inherent quality of every Curtis product, a little extra maintenance care now will extend an year of usefulness to help carry through today's critical times.

INSTALLATION Be sure your compressor is in a clean, dry location in a level position, mounted solidly on a concrete foundation or built on an iron base. If motor drive, see that compressor and motor operate at recommended speed, in proper direction, and that motor specifications agree with current available.

LUBRICATION Maintain proper oil level—check daily—oil only through oil filler cap—follow manufacturer's instructions. Use light grade auto cylinder oil. Drain and refill every three months. Keep oil off of belts.

COOLING WATER Calculate a continuous supply of cooling water through jackets—either by connection to water line or with water circulating pump. Under full load, cooling water should not exceed 125° F. When pump is used, keep pump suction always flooded.

SERVICING Drain moisture from air tank at least weekly, preferably every day. When replacing head gasket, secure proper grade of material from manufacturer—do not use paper or soft rubber. Keep compressor clean.

TESTING If an supply or pressure decreases, rest all engines, joints, and valves for leaks—using soap water and brush. Periodically inspect check valves, safety valves, and valves in head of compressor. If they leak, remove and clean—oil them so as to work freely. Keep flywheel tight on shaft with nut and lock washer.

GENERAL Discharge piping should be full size of compressor opening, as short as possible, with minimum number of bends. Don't use steam or water check valves, use disk port or disc type. We recommend "V" belt drives with take-up power-act. Consult maintenance book when making repairs or replacements—when ordering parts or repairs, give serial number on manifest.

By following these few service suggestions, you'll find your Curtis Air Compressor to operate at peak performance throughout an unusually long, trouble-free life.

CURTIS

Curtis Pneumatic Machinery Division
of Curtis Manufacturing Company
1957 Kingston Avenue St. Louis, Missouri
CONSIDER METAL—BUY WAR BONDS

HELPING THE

Aircraft Industry

DO MORE THAN
THE EXPECTED™



WESSON
Carbide Cutting Tools
The World's Most Versatile and Dependable
Cutting Tools for the Aircraft Industry

More than the expected! Right Today our Aircraft Industry is out in front—ahead of schedule—and the biggest production job ever tackled by any industry is perfectly "tacked."

Planning, meeting every challenge? Wesson Carbide Cutting Tools have helped to make this possible—by making short work of extra production jobs on toughest metals and alloys—with fewer setups, greater speed, bigger bits, and a minimum of rejects.

The new metal cutting standards set by Wesson in aircraft motor production will be the "yardstick" of performance for machine tools of the future. The career of Wesson engineers—skilled in engineering and designing of cutting tools—is available to help solve present war production problems, or for post-war planning. **WESSON CO., DETROIT, MICH. (Parsdale Station)**

IN HAPPIER DAYS TO COME we will of have better, safer automobiles—more efficient refrigerators, washing machines and vacuum cleaners—aircraft will have better, stronger motors and other tools and machines.... aircraft will continue to set new

standards in speed, comfort and safety—all made possible, in part, by the Wesson development of Carbide Cutting Tools to make high standards that they cut tougher metals than ever before—with greater precision—and at greater speed.

of 2,000 sheet per roll is stated to be accurate within 1 percent. Main is treated and supply has double lead—**WATSON, ZION, ILL.**

Rubber Gaskets 46

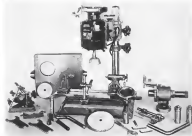
Rubber gaskets available in various sizes, with natural rubber or with damaged materials replaced in **J. T. Goodrich Co., Akron**, are being used in glass and tanks. *Aviation*, June, 43



applied in industrial and low line pressure successfully. Material is available in round, square, or rectangle for shapes up to 12 1/2 in. long. Flat-pressed dimensions are not less than 1/4 in. or more than 1/2 in. **Watson, Zion, Ill.**

Cutter Grinder 49

Featuring, motor driven head which can be switched, ground and honed by various adjustment, new machine built by **Essex Mills Co., St. Joe, Wis.**, is designed to grind wide and fine milling cutters, and mills, tapered, straight or spiral inserts, and bars, counters, haws, ballers, reamers, etc. Having features and accessories are provided slide that can be used independently.



NEW PRODUCTS

for separating tool-and-rod grinding because the holding and rolls and rollers. Base of unit is 18x16 in. rollers is 24 in. high and weight, complete with rollers is 153 lb.—**Armstrong, Zion, Ill.**

Fuel Pumps 76

Several standard size fuel pumps, most of them fitted with relief valves, regulating discharge pressure, are being marketed by **Pump Engineering Service Corp., Cleveland**, for pumping gas from tanks in automobiles. *Ill.*



rotary, from a positive displacement type, they are used to work rapidly and in other direction. In aluminum after having surface counter-bored.



NEW FACING TOOL..

Cuts tool costs 75%



Facing just with this tool—done from side surface from



Clear, shapable bits. Cutters remove in double length in an extra time, just about as fast. Only need one piece of diamond dresser 1/2" to 1" wide in 1" diameter.

Only improved to replace this long-running bit of tool industrially available with straight or bevel shoulder. **MOVI**—except only present delivery on suitable priority.

Ask for new Bulletin No. A-2

ROBERT H. CLARK CO.
200 South Broadway, St. Louis 10, Missouri
Manufacturers of Precision Tools for the Aircraft Industry

DESIGNED FOR WORK "Upstairs"

A tough synthetic sheath, providing exceptional resistance to moisture, heat, oil and ozone, distinguishes the Packard high-tension cable that has been adopted for high-altitude flying by the Army Air Forces.

Two years of Packard pioneering and development are behind this type of cable, which has won wide acceptance wherever extreme conditions of service are encountered. Now refined and improved, Packard high-tension aircraft cable with the synthetic sheath is helping meet the problems of the "45,000-foot ceiling." Packard Electric Division, General Motors Corporation, Warren, Ohio.

Packard
AIRCRAFT
IGNITION CABLE



PACKARD CABLE SERVES THE ARMED FORCES
in trucks • jeeps • tanks • armored cars • planes •
aircraft instruments • anti-aircraft gun controls •
landing boats • radio equipment.



NEW PRODUCTS

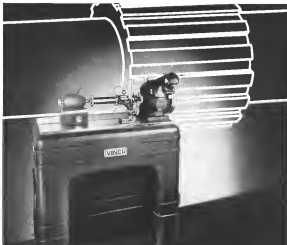
There is little risk in doing so, shaft connected with engine drive gear. The driving motor has large outer edges of blades in contact with base of stone except at high speeds when centrifugal force maintains blade contact. Capacity of model illustrated is 480 gph at 2,500 rpm.—American, June, '63

Versatile Stripper 71

Extending need for tedious stripping, 8,000 stripper, manufactured by Bantling Versatile Co., Hazen, Pa., is applied to electrical and other parts which are to be kept scratch-free. After treatment with product, run scratch which drops on parts automatically can then be readily removed with sand or fine abrasive buff.—American, June, '63

More Machineable Alloy 72

Addition of aluminum to low thermal expansion 35 percent nickel alloy known as Invar is reported by Carpenter Steel Co., Reading, Pa., to increase the metal's machineability and save machining time. Top plate shows regular grade Invar being turned with difficulty, revealing a beveled edge, while similar operation on



2/1,296,000ths!

EXACTLY! Two-one millionth of an inch and ninety-six thousandths of a circle THAT'S SMALL, ISN'T IT? That is only TWO SECONDS OF A.C. That would be, let's see—mmm—less than .0004" on the circumference of a circle 10 feet in diameter . . . less than 1/3 of an inch on a circumference of MORE THAN THREE MILES!

What does it mean? Why, that is the amount of error that creeps in on the VINCING OPTICAL MASTER INSPECTION DIVIDING HEAD'S accuracy. Sometimes it is even less!

Today, most of the great producers of moment in America are using the VINCING DIVIDING HEAD to check gears, index plates, splines, cams, camshafts, etc., to limits that formerly were believed impossible.

Further information regarding this accurate inspection instrument will be sent upon request.

MILLIONTHS OF AN INCH
FOR SALE BY
VINCING

VINCING CORPORATION
8643 SCHARPER HIGHWAY
DETROIT • MICHIGAN

"LITTLE LIGHTNING"

they call 'em in airplane plants.... these

UNITED STATES SPECIAL STREAMLINED AVIATION DRILLS



MODEL AKS 1/4"

Weight Only 3 1/2 lbs.

MODEL AKS 3/8"

Weight Only 4 1/2 lbs.



For use in cramped quarters where only "jolt" type drills can give power. All drills while motor while at speeds from 150 to 5000 rpm. Designed up to fit the most difficult sites.

Each drill with universal motor, 750 to 5000 rpm.; ball bearings set in steel retainer; switch with locking pin, center of trigger rear end permitting right or left hand use; removable cover on handle for easy replacement; 1/4" 3-chuck; screwed on spindle; covered rubber attachment plug.

Reasonably prompt deliveries. **WRITE NOW.**

DRILLS . DRESS STANDS . YACHT SEAT DESIGNERS . VALVE
REFINISHING MACHINES AND SHOPS . PORTABLE GENERATORS
PORTABLE SANDERS . FLEXIBLE SHAFT MACHINES
LATHE GRINDERS . GRINDERS . BUFFERS . POLISHERS



THE UNITED STATES ELECTRICAL TOOL CO.

CINCINNATI, OHIO, U.S.A.

NEW PRODUCTS

100, two-machine grade is easily placed (below) with greater ease—*Aviation, June, '43*

Coolant Pump 73

Model VBB coolant pump (see photo) has three outlets for piping on right or left side or into pump through intake bracket. Two other models, each also



available in 17 sizes, were designed for submersible use and for vertical and horizontal external mounting. Maker is Pioneer Pump and Mfg. Co., Detroit—*Aviation, June, '43*.

Plywood Tester 74

Compression or stress detection of a piece of plywood, placed within this device, is measured by scale of indicator, while dial on left shows changes in lengths of the diagonal. This is "a comparatively new method of general investigation of plywood," announces Sawyer-Kent Co., Chicago, maker of tester, "and it seems likely to yield a (Turn to page 255)



How a life raft holds its breath

Lost and out of gas . . . The long final glide comes to an end with a sudden pit . . . on the vast expanse of ocean. Then the scramble to get clear of the sinking phase. Overboard goes a compact bundle of rubberized fabric and in a twinkling it becomes a bright pillow heaven . . . a means of rescue.

These life rafts are automatically inflated from a bottle of highly compressed carbon dioxide gas. When

the gas charge is released, the raft, like a huge lung, takes a deep breath, and holds it!



Schrader
CONTROL VALVES
FOR PNEUMATIC RAFTS

In addition to the valve through which the original charge of gas passes, each raft or boat is fitted with several valves constantly open so that pressure to maintain buoyancy may be added, by means of a hand pump, when necessary.

These are but two of the many types of Schrader Valves that have been specially developed for the important job of saving lives in wartime.

A. SCHRADER'S SON, Division of Inverly Manufacturing Company, Incorporated, BROOKLYN, NEW YORK

AVIATION, June, 1943

AVIATION, June, 1942



STAINLESS STEEL

STAINLESS steel is playing an important role in Allied war production. Our aircraft, warships and motorized units utilize this strategic material. Production of chemicals, explosives and synthetic rubber is facilitated by use of stainless steel equipment. In many other fields, where high tensile strength and resistance to heat or corrosion are demanded, stainless steel is specified.

As America's largest and only exclusive producer of stainless steel, Rustless is filling a substantial portion of these wartime needs. Rustless is doing more. Through use of its unique process, Rustless is conserving America's limited resources of chromium and electrolytic nickel. This is important, because the stainless steel industry is the largest consumer of low-carbon ferrochrome and electrolytic nickel, both of which are among the most critical of strategic materials.

The Rustless Process is based on the use of sub-grade chrome ore and stainless steel scrap, of which there are adequate supplies in this country. More than 49% of the nickel used by Rustless is obtained from scrap, while only 5% of its chromium comes from low-carbon ferrochrome. Thus Rustless is not only meeting wartime demands, but through its conservation efforts is also assisting greatly in meeting the critical supply problem of these two metals.

These advantages of the Rustless Process will be of equal benefit in meeting a greatly expanded use of stainless steel after the war. When that time comes, Rustless will be ready with a fund of new technical knowledge and specialized experience to devote to the problems of peace.

RUSTLESS IRON AND STEEL CORPORATION, BALTIMORE, MD.

RUSTLESS
CORROSION AND HEAT-RESISTING
STAINLESS STEELS



WATERSHED from Tulagi to Tunis

DEEP in a concrete vault, the Naval Observatory's time machine ticks out a signal broadcast around the world. Our national coordination is kept to this watch word of accuracy. For the physical coordination we depend on another precision time machine — the air craft engine — which makes the most of time available. Wright engines, in larger, better, better, better, are the watch word of progress in time saving, message air transport.

Wright
ENGINES

CONCRETE
POWERFUL



When the War is Over...

Boots Self-Locking Nuts will have even more widespread usefulness today. They are used in a variety of applications, including all types of AIRCRAFT, AUTO MOTO-BUSSES, RADIO CONSUMERS, etc. Furthermore, they will lighten the life of your AUTOMOBILE, BOAT, WASHING MACHINE, VACUUM CLEANER, ELECTRIC REFRIGERATOR, and many other household appliances, as well as industrial, farm, and office machinery. Boots Nuts provide positive protection of permanent fastenings wherever vibration, corrosion, or temperature are factors.

200 Rounds May Spell the Difference

Boots all-metal, self-locking nuts are lighter than ordinary nuts. Their use on heavy bombers saves more than sixty pounds of precious weight—a saving which can be turned into sixty pounds of fire-power, or about 200 rounds of .50 calibre machine gun ammunition. And those 200 rounds may easily mean the difference between "all our aircraft returned safely" and "one of our aircraft is missing."

All types of U. S. planes are protected with Boots Nuts. Not only are these nuts lighter, but they literally "outlast the plane." Furthermore Boots Nuts cut repair and maintenance time and have great reusability. They meet the exacting requirements of all government agencies.

"They Fly With Their Boots On—Lighter!"

BOOTS

Self-Locking Nuts For Application to All Industries

BOOTS AIRCRAFT NUT CORPORATION • GENERAL OFFICES, NEW CANAAN, CONNECTICUT

considerable amount of information on how plywood of various constructions sets in place.—*Aircraft, June, '43.*

Hydraulic Test Stand 75

Long used by air armies, portable hydraulic test stand designed by Denison Engineering Co., Columbus, Ohio,



can check entire plane hydraulic system from 500 to 3,000 psi. on power from 1½-hp., 220-v. motor. In operation, plane's various and pressure lines are connected to stand, valves of flow is adjusted up to 5.2 gpm., and tester's relief valve is set for higher pressure than that in plane. Checking is then conducted in same way as under flight conditions.—*Aircraft, June, '43.*

Conveyor-Trolley Lube 76

J. N. Turner Co., Detroit, announces new device for controlling and applying lubricants (oils to heavy lubric greases) to bearings of conveyor trolleys where an trolley wheel approaches lubricator, which is mounted on trolley rail, lubes even in contact with stems of one of five pumping units, then conveying it with wheel bearing. Rotation of lubricator are pumps lubricant through di-



ing to wheel bearing. Unit is available with reservoir of 5- or 15-lb. capacity.—*Aircraft, June, '43.*

Protective Coating 77

Alloy-Sprayer Co., Detroit, describes a process of applying metal coating to areas formed by welding and of painting small dissimilar areas of large oil-coated assemblies. It is reported that actual spraying of sprayed metal with low metal appears to be offered, major sandblasting and other preparation of base satisfactory under various conditions. Coating, known as Galv-Weld, is a high alloy lead with a melting temperature of about 800 deg. F. It can be sprayed on areas depleted by too or excessive welding while they

are still hot; otherwise part to be coated is heated to 200 to 475 deg. F. Spray gun, which has thermostatically controlled heating jet, can apply a coating of from .001 to .006 in.—*Aircraft, June, '43.*

NEW PRODUCTS

MAGNIFIED

Auburn

CERAMIC SPARK PLUG CONNECTORS

The picture is magnified—but the importance and dependability of this vital part in maintaining constant contact cannot be over-emphasized.

Auburn Ceramic Connectors give full assurance against carbon-tracking, carbonization and moisture absorption. They are certified Auburn products and officially approved.

Made in two sizes as illustrated

Exquisite record from angles and known magnification

AIRCRAFT DIVISION
AUBURN SPARK PLUG COMPANY, Inc.
1180 Raymond Blvd. Newark, N. J.

ACTUAL SIZE

No. 1041—3/8" No. 1042—1/2"

AUBURN SPARK PLUG COMPANY, Inc.
MAIN OFFICE AND FACTORY, AUBURN, N. Y.

What is the FAST, ACCURATE WAY to TRIM AIRCRAFT STAMPINGS?



New, standard, and complicated parts—required by new aircraft designs and other special war equipment—are being trimmed, formed, or built as Quickwork-Whiting Stampings Trimmers. In many instances, these Quickwork machines have cut to seconds operations

that were formerly done by slow, cluttered work methods.

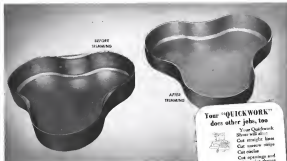
If you have stampings of any kind—staplers, darts, or other alloy—or any shape, investigate Quickwork-Whiting Stampings Trimmers. By trimming, forming and operation, and spending up trimming or forming operations, they can break production bottlenecks in your plant.



Also, required Stampings are trimmed into shape in a single pass.



Standard Quickwork-Whiting Stamping Trimmer



QUICKWORK-WHITING DIVISION

WHITING CORPORATION

15633 LATHROP AVENUE, HARVEY, ILL.

The Aviation Industry Is Served by Whiting Corporation with Cranes • Machines • and
Matched Maintenance and Handling Equipment

NEW PRODUCTS

Steel Saver 78

Knox Aircraft Co., San Diego, has made available to war aircraft manufacturers plans of a new landing fork which has saved many pounds of



steel per day in best landing operations. When friction time based loading and removal of white-hot trays from furnace were cut six days a day, employees designed them and took landing fork (discontinued) which makes one tray last whole day—AVIATION, Jan., '43

Drill Jig 79

New type beam drill jig unit, known as Puffer Current, is announced by Earl C. Parkhurst, Inglenook, Calif. Contrasted of normalised cast metal tree, it permits toolmaker or driller to get into operation soon, he merely



40,000 feet is *Tough on Headphones!*



Buy BONDS for
VICTORY!

Permo-Flux Dynamic Headphones Excel at High Altitudes....

In war as in peace, Permo-Flux Acoustical Developments are leading the way. Permo-Flux Dynamic Headphones, ingeniously designed to compensate for pressure differences at all altitudes, assure increased accuracy and better signal intelligibility under every operating condition.

With the coming of Victory, Permo-Flux Acoustical Products will again be available to all. Meanwhile, inquiry is invited on essential sound reproduction problems.

TRADE MARK
PERMO-FLUX
CORPORATION

4916-22 W. Grand Ave., Chicago, Ill.

PIONEER MANUFACTURERS OF PERMANENT MAGNET DYNAMIC RECEIVERS



From original photograph by Gordon Greenaway

The stars, unvarying in their course, are the celestial guides of aircraft and ships. The precision of their movements assures the most complete accuracy. Precision is vital, too, in the bomb racks and shackles which we build. We were doing precision work of this type before the war...and will be doing it afterward.

**PRECISION
CRAFTSMEN**

NATIONAL MACHINE PRODUCTS
150 WEST SLAUSON AVENUE • LOS ANGELES • CALIFORNIA



without digging through base. Width of groove is measured by a micrometer, and this figure, together with weight necessary to make groove, are interpreted into shear-hardness by mathematical formula.—*Aviation, June, '48.*

Vise and Angle Plate.....85

For angle milling, drilling, boring, grinding, slotting, boring, tapping, etc., new precision vise can be mounted by "V" bolts in any type of machine tool where it weighs 150 lbs. in top plate, 90 lbs. in vertical, and 300 in bottom. Made by Wometco Co., Detroit, vise is furnished in two sizes, one 6½ in. high, with jaw opening up to 4 in., others 4½ in. high, jaw 1½ in.—*Aviation, June, '48.*

Plastic Clamp Grip.....84

New grip of heavy extruded plastic is being supplied by Detroit Stamping Co., Detroit, for handles of its line of De-Sta-Co toggle clamps. Plastic has re-



possessive and physical properties of rubber, but it is repaired unaffected by oil and grease.—*Aviation, June, '48.*

Resin Sealer.....87

Marine A.P. specification AN-517, Aero-Kas, supplies resin sealer developed by J. F. Leach, Inc., Seattle, can be applied to aircraft woods by brushing, spraying, or dipping. Made opaque this sealer is transparent and can be applied directly to pine or kiln-dried wood, or which is cut either as a non-plate interior finish or undercoat for

topcoat or enamel. It can be formulated at temperatures up to 150 deg. F. Product is also used for making aluminum pigment paint under specification AN-TT A-141.—*Aviation, June, '48.*

NEW PRODUCTS



**HARDNESS
TESTER
for
SOFT METALS
and
PLASTICS**

**The
Impressor**



Light, small, handy, simple, convenient to use, and easy to carry. Simply press the spring-loaded indicator point against the surface, and the dial immediately shows the relative hardness of the material. Widely used in aircraft and other war goods plants for checking aluminum, aluminum alloys, and other nonferrous metals, as well as plastics, hard rubbers, and the like. Write for complete information and prices.

BARBER-COLMAN COMPANY
ROCKFORD • ILLINOIS



Working Tools

• Designs, production and purchasing men make good use of Booth's combination felt application chart and sample file. Contains small swatches of all S.A.E. felt types . . . felt which (when precision die-cut into Booth mechanical felt pads) serve existing aircraft and other key industries.

Complete specification tables are included . . . and the file is bound standard file size. Write for it . . . no obligation . . . no sales follow-up.

THE BOOTH Felt COMPANY
482 12th Street, Brooklyn, N. Y.
140 Madison Street, Chicago 18, Ill.



NEW PRODUCTS

Paint Gun Cover 22

To ensure longevity of aluminum and steel fine paint sprayer nozzles and valves, Master Mfg. Co., Chicago, is



working on a cover which fits most standard quart friction-top paint cans. —*Aircraft*, June, '63

Engine Heating Unit 29

Developed and manufactured for the ground services by Hercules Motor Corp., Nicholas, Ill., diesel fuel burner, now here in use at a hotelboat, is now available in models using gasoline for engine blower and heater fuel or No. 2 fuel oil for heating. Warm air is drawn through screens ducts by gasoline engine, which also drives a scroll-shaped fan providing air for ventilation. Retractable wheels can be lowered to rest, weighing 295 lb. without ducts, can be moved like



wherever. Capacity is 250,000 Btu per hr. at 60 deg. F. inlet temperature. Dimensions are 20x16x12 in. —*Aviation*, June, '63

Percentage Timer 30

K. W. Greiner Co., Cincinnati, Ohio, is producing a percentage timer for controlling interval during which



any act must be closed or opened in a definite time cycle. Device may be employed where one function here, a definite time relation in percentage or operation of a second function, such as in regulation of input to furnace and even in controlling proportionate flow of elements for boiler feed water treatment. Timers, available in series ranges from 30 sec. to 60 min., total cycle, have single pole, single throw 20 amp. resistant coil are enclosed in dust-proof Bakelite case of 3½-in. dia. and 1½-in. overall height. —*Aviation*, June, '63

Tool Post Grinder 91

For internal, external, face, and taper grinding on balls, slugs, plates, rollers, or blanks, Lemco Products, Madison, Wis., is producing machine which includes 4½-in. deep. Single quill assembly, statically and dynamically balanced, is designed to do double service, meet

NEW PRODUCTS

by motor may be shifted 2 in. or slide bracket. Quill is mounted in four pre-loaded, lubricated, matched ball bearing sets, and two-step 1½-in. pulley provides variable speeds of 6,000 to 13,500 rpm. —*Aerospace*, June, '63

Motor Control 92

Met-A-Trol is made possible by Westinghouse Electric & Mfg. Co., East Pittsburgh, is now electronic controller providing 50 to 1 speed range for d.c. motors on individual drives operating from a.c. sources. Now available for 1½- or 220-v. 60 cycle motors up to 1 hp., or a.c. drive line four phase. Power transformer selected, motorizing (three-phase, current limiting, and speed



regulating controls, push button control station with potentiometer to vary field current and maximum voltage, and a short-circuit d.c. motor. With a range of 18-to-1 and with torque varying from none to full load, speed is reported not

'FIRST LINE' Tools for 'FRONT LINE' Equipment



CLARK

DRILLS • GRINDERS • SANDERS

For over 50 years Clark has been building drills, grinders and sanders that have been so manufactured that they can really take it. By their own special method of Controlled Construction added years of service have been built into every tool.

On the home front and on the battle front, you will find Clark tools doing their part to speed Victory.



drills • grinders • sanders



JAS. CLARK, JR. ELECTRIC CO.

566 BERGMAN ST., LOUISVILLE, KY.





"... and they'll come marching down our street!"

Boys will play, boys play, boys will play
—that day when we welcome our
heroes home.

You will be there, too, cheering too
Not quite understanding the term in
your eyes and the lump in your throat
Then we shall turn our faces forward—

To a way of life in which kids like
you can grow up straight and strong
and self-knowing soldiers wave
and cheer.

To a world that can offer jobs, homes,
opportunity for all.

Sparton, right now, is making an
investment in that future.

Reaping old skills in new war tasks.

Building homes, sewers and winning
signals of all types.

Plus a wide variety of special material.

A sort of 14 major products—

Including highly induced equipment
to meet the striking requirements of
the Radio Division of the Signal Corps.

After Victory—what?

From these same plants will come
new and finer products for the auto-
mobile, marine and aviation fields.

New, re-born Sperton radios, too.
And other exciting home products.

Plus shared with Sperton.

Peace is the beginning—the end.

PLAN AHEAD WITH SPARTON! It's more conspicuous with whom you are
associated in your marketing opportunities, in which you 45 your reputa-
tion in electrical precision manufacture can be valuable.

SPARTON

PRECISION ELECTRICAL MANUFACTURERS SINCE 1909



THE SPARTON ENGINEERING GROUP - JAMES W. SPARTON, JR. CHAIRMAN OF BOARD, LEO SPARTON, VICE-CHAIRMAN

NEW PRODUCTS

is only more than 8 percent from its
present rate, maximum variation for
20-to-1 speed range is within 5 percent.
Motor is only moving part, so line
errors in field rheostats being elimi-
nated.—*ASTORIA, June, '33*

Tension Control..... 93

An injury to two dozen trails and
thousands of acres can be controlled by
single shift of new switch developed by



General Mig. Co., Brooklyn. Design-
ing of a unit for each tract has permitted
moving all axle cars mark penetrated
by shift which locks with each roller.—
ASTORIA, June, '33

Oscillograph..... 94

Features of new Type 561 ortho-
dynamic oscillograph developed by Allen B.
Dr. Mort. Subsequent, Inc., Paterson,
N. J., is large screen (2 ft. dia.) and
X-ray amplifier to modulate beam with
any signal applied to its input dev-



SKILL COUNTS IN AIRCRAFT WELDING

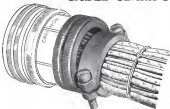
★ Kay Products Company occupies a unique position in the
aircraft industry. Organized more than five years ago for the sole
purpose of serving the Army Air Forces and leading airplane
manufacturing companies, it has developed men and facilities for
the production of aircraft parts and assemblies. Welding technique,
particularly, has been carried to a high degree—and through re-
cent increases in facilities and personnel, we now offer the welding
experience of this company in a limited number of new customers.

KAY PRODUCTS COMPANY

4825 CABOT STREET, DETROIT, MICHIGAN
DIVISION OF TYLER FIXTURE CORP., MILES, MICH.

AIRCRAFT WELDING

THE CANNON "AN" CABLE CLAMPS



...give security in operation and diversity in application!

Type "AN" cable clamps are designed to fit all eighteen shell sizes in Types AN3100, AN3106 and AN3108 Cannon shells. This includes the wall-mounting unit, the straight connector and the angle 90° connector of an AN series.

Fabricated of aluminum alloy, these Cannon AN cable clamps eliminate the need of flexible metal conduit, thus conserving essential wire metals. They fit snugly on a certain number of wires but have to be built up if wire cable diameters are smaller than the clamp maximum. Cable entrances range in size from 17/64" to the maximum of 3-13/32".

Cannon cable clamps, like Cannon Connectors, are designed and developed to meet the most exacting requirements of engineers. They are precision-made with one thought in mind—to manufacture the finest product of its kind, dependable under any and all sorts of operating conditions.

New Second Edition Ready!

AN Cable Clamps are completely described in the new Cannon AN catalog. If you have not yet received your copy, address Department 1, Cannon Electric Development Company, Los Angeles, California.



CANNON ELECTRIC

Cannon Electric Development Co., Los Angeles, California
Credit Policy and Engineering Office: Same as Above Co., 14, Toronto

REPRESENTATIVES IN PRINCIPAL CITIES—CONSULT YOUR LOCAL TELEPHONE BOOK

NEW PRODUCTS

minute or with a return time blanking impulse produced by linear time base generator. Uniform T-scale (vertical) line deflection response of 50 cycles per sec to 5 megacycles, X-ray (horizontal) deflection amplifier) a uniform electron deflection of 50 cps to 180 kilocycles. Beam can be connected directly to deflection plates when observed frequencies are beyond amplifying limits. Operating from 115 v 60-cycle line, unit weighs 65 lb, measures 17x18x14 in.—AERO TECH, June, '63

Indicator Light 55

"Retro-lite" is name given by Leland-Turn, Inc., Chicago, to new indicator No. 1554 which operates by fluorescence



under black light. Cap is transparent plastic and body contains a side-will. Activation is effected to fluorescent butterfly indicator valve by simple lever. Butterfly opens to show signal.—AERO TECH, June, '63.

Flow, Pressure Controller.... 96

The Bristol Co., Watertown, Conn., has recently improved its open stand liquid level for automatically controlling flow, liquid level, pressure, draft humidity, and temperatures up to 3,000 deg F. Incorporating same basic free-flow



NEW PRODUCTS

principle as previous models, controller can be converted to various types of work. Unit is offered in three types: Manual (on and off), analog (throttling), pneumatic, on-off, and magnetic.—AERO TECH, June, '63

Spark Plug Connector 77

Aircraft Division of Auburn Spark Plug Co., Newark, N.J., announces im-



proved, modified contact terminal for corrosion resistance against wire and spark plug. With a series of viton, porcelain ceramic, connector is available in 9/16- and 3/4- inch lengths assembled with metal eyelet and stainless steel contact spring.—AERO TECH, June, '63

Tap Recyclifiers..... 98

Now in mass production by Detroit Tap & Tool Co., Detroit, these mounting machines are designed to handle taps of virtually all types and sizes.—AERO TECH, June, '63



SOILPROOF. WATERPROOF. PLASTIC SEALED ARMBANDS

- ... improve employee morale
- ... increase pride in work
- ... facilitate worker cooperation
- ... speed production for victory

Porous companies throughout all industry now are using these plastic sealed armbands. They are finding they help produce more—better—faster. This is because they identify key employees by proper title, eliminate confusion, and increase the worker's pride in his position just as simple of rank contribute to morale in our fighting forces.

AVAILABLE AT NOMINAL COST— either with your company name imprinted or in stock designs, they can be made up for you in your choice of a wide variety of sizes and styles. Department names or employee titles can be shown.

MANY OTHER PLASTIC ITEMS— can be supplied promptly. Tool checks, identification badges, job ticket holders, with or without company identification are included. All are of highest quality, scientifically designed to meet your needs.

You'll find they serve your best needs, many times over.



PLASTIC DIVISION

HOLLYWOOD ATHLETIC CO., 211 E. 7th St., Los Angeles, Calif.

Please send me at once, samples and prices on items checked below:

ARMBANDS ☐ IDENTIFICATION BADGES ☐ TOOL CHECKS ☐ JOB TICKET HOLDERS ☐

Company _____ City _____

Address _____ State _____

Signature _____ Title _____





HOLO-KROME

Internal **HEX** Wrenching

BOLTS

NASC SPECIFICATIONS

Alert to the quality requirements of the Aircraft Industry, every precaution is taken by the precision trained Holo-Krome personnel to rigidly maintain the exacting standards to which these Completely Cold Forged Bolts are manufactured.

The continuous, unbroken fibre flow (etched cutaway view above) at the juncture of the head and body and through the entire Bolt is the result of the exclusive method of Completely Cold Forging, patented and utilized solely by Holo-Krome.

To AIRCRAFT DESIGNERS — the result is

unfailing *PERFORMANCE*

All Holo-Krome NAS Bolts are furnished with ground bodies.

AIRCRAFT DIVISION — THE HOLO-KROME SCREW CORP., HARTFORD, CONN., U. S. A.

UNRETOUCHED PHOTO ETCHED
CUTAWAY HOLO-KROME BOLT

Features
shown above

- 1—INCREASED STRENGTH
- 2—CONTINUOUS UNIFORM LATERAL DE FLUXED CORE FIBRE
- 3—CONTINUOUS UNIFORM FIBRE
- 4—SMOOTH FLAT TOP WITH SLIGHT CHAMFER
- 5—CONCENTRICITY OF HEAD WITH BODY
- 6—SOCKETS — UNIFORMITY ACCURATE TO FULL DEPTH OF HOLO-KROME HEXAGONAL SHAFT—ACROSS FLAT, BETWEEN SQUARES IDENTICAL TOP AND BOTTOM—AND SUPER-SMOOTH REGULAR WALLS—WELL FINISHED CORNERS
- 7—CONTINUOUS FIBRE ENDING IN SMOOTH WALLS
- 8—REINFORCED SOCKET WALLS
- 9—CONTINUOUS UNIFORM FIBRE
- 10—SQUARE SHOULDERS
- 11—ORIGINAL CONTINUOUS FIBROUS STRUCTURE

Milling Coller. 99
Minimizes spring collars in mass from 1 to 50 in. are now obtainable where milling machine collars either cause too much. Collars are designed to



give positive adjustment for spring straddle rolls without removing collars or collars from arbor. Miller, Dayton Rogers Mfg. Co., Minneapolis, also furnishes special gas-tight spacer wrench—*Airplane*, June, '42.

Leveling Jack. 100

Applying wrench to her head of adjusting screw raises or lowers leveling jacks designed to be placed under machinery, assemblies, etc. Upper and lower castings permit fastening for self-alignment, and smooth slippers allow upper one to slide under object. Used with three adjustment capacities (1, 1 1/2 and 1 3/4 in.) is available from Kasperman Machine Parts Corp., Detroit—*Airplane*, June, '42.

Phenolic Resin Binders. 101

Phenolic resin adhesives, produced by Dana Plastics & Chemicals, North Tonawanda, N. Y., were used to bond hardened veneers in the manufacture of this aerial delivery container. Shown and resin, manufacturer reports, has impact strength of 6.31 to 6.35 ft/lb foot, compressive strength in excess of 20,000 psi, and tensile strength of 7,000 to 9,000 psi. After two-hour bak-



NEW PRODUCTS

ing at 140 deg. F., shrinkage was not related as .003—*Airplane*, June, '42.

Welding Tip Cleaner. 102

Photo shows "before and after" condition resulting from cleaning process for gas welding and flame cutting tips. Leveling Collar compound No. 32. En-



dred of removing carbon, scale, and tars by heating, soaking, and buffing. Oakite Products, New York City, recommends that tips be removed first in heating cleaning solution, cold-soaked, then put in soap-and-water, given bright dip, acid and hot rinse, and scrubbed. Process is explained in a company service report—*Airplane*, June, '42.

Red Rod Boring. 103

Self-aligning rod and bearing for control coupling and compressed bearing rotating within ball part requiring no



lubrication. Four standard types to fit most ball bearing rod ends are available through Ransome American, New York City—*Airplane*, June, '42.

IT'S WIRY JOE FOR AVIATION WIRE and CABLE



There was a time that Wiry Joe was merely the largest independent manufacturer of replacement wiring for the automotive industry.

Now, Wiry Joe is also known as an important source of supply for every type of electrical wire and cable for aircraft. The complete line includes starter cable, high tension cable, primary cable, both original and replacement. Wiry Joe also makes power and welding cable.

And just as Wiry Joe automotive cable was a name for quality, so too, has Wiry Joe aviation cable. Every step in the line is built to meet rigid Army and Navy specifications, and is produced under the Dostan method of manufacturing for uniformity, dependability, high efficiency and long life.

Logistics regarding wire and cable for any type of service will be answered promptly.



Wiry Joe
AVIATION CABLE

Manufactured by
THE CRITCHFIELD COMPANY
Pittsburgh, Bridge Island

Harmony Between Air and Ground Forces Made Allied Tunisian Triumph Possible

New analysis of the events that led to the Allied triumph in North Africa goes to Africa. The Allies will have to be coordinated from future study of records. It was in this analysis that the Allies had to be coordinated from future study of records. It was in this analysis that the Allies had to be coordinated from future study of records.

Box Score

ALLIED NORTH AFRICA victory losses have been estimated at a total of 5000 craft destroyed in the air and more than 100,000 in the ground. The Allies had to be coordinated from future study of records.

With the Tunisian campaign ending up on the Allied side, the Allies had to be coordinated from future study of records.

Some through mid-April of the specific bombardment, the Allies had to be coordinated from future study of records.

Countdown strategy to Allied success was perfect harmony between the American and British air forces and between the air and the ground forces. Further coordination was essential to the success of the campaign.

Secretary of War Henry Stimson said a preliminary report of the Air Force was that the Allies had to be coordinated from future study of records.

Further coordination was essential to the success of the campaign.

"Thunderbolts" Announced in Action

Specific P-47 Thunderbolt attacks are underway in the air. The Allies had to be coordinated from future study of records.

Attack was reported in a series of 400 mph. Some Thunderbolts were reported in a series of 400 mph.

Attack was reported in a series of 400 mph. Some Thunderbolts were reported in a series of 400 mph.

Attack was reported in a series of 400 mph. Some Thunderbolts were reported in a series of 400 mph.

In their first major action, "Thunderbolts" scored "Big Pointers" as a full Army and brought news at last for PW-260.

The victory is great. It was a triumph for the Allies. The Allies had to be coordinated from future study of records.

The Foreign Lines Get Miami-Caribbean Permits

CAR has granted temporary permits to five foreign lines for service between Miami and the Caribbean. The permits are for the lines of the Caribbean.

ICIA Begins Survey of Postwar Problems with CAB Questionnaire to Industry

Washington (AP)—The International Civil Aviation Organization (ICAO) has begun a survey of postwar problems with a questionnaire to industry. The survey is to be completed by the end of the year.

The survey is to be completed by the end of the year. The survey is to be completed by the end of the year.

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At the same time, the Allies had to be coordinated from future study of records.

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A Canadian Yukon rancher shot by the Allies. The Allies had to be coordinated from future study of records.

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The Allies had to be coordinated from future study of records.

The Allies had to be coordinated from future study of records.

The Allies had to be coordinated from future study of records.

Photo of Yukon rancher

SEAFIRE COMES IN

Seafire came in to land. The Allies had to be coordinated from future study of records.

The Allies had to be coordinated from future study of records.

The Allies had to be coordinated from future study of records.

The Allies had to be coordinated from future study of records.

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The Allies had to be coordinated from future study of records.

The Allies had to be coordinated from future study of records.

The Allies had to be coordinated from future study of records.

Photo of Seafire

Military News

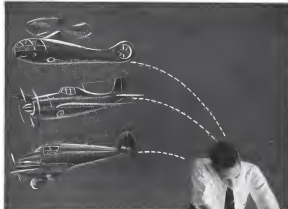
OWI reports that the Allies had to be coordinated from future study of records.

The Allies had to be coordinated from future study of records.

The Allies had to be coordinated from future study of records.

The Allies had to be coordinated from future study of records.

The Allies had to be coordinated from future study of records.



TRANSITION TO TOMORROW

Aviation progress is being paced by far-sighted men who are now laying the groundwork for future leadership.

The emergence of the civilian plane of tomorrow from the fighting plane of today — a tremendous acceleration in aviation development — has already begun on paper.

We invite consultation regarding immediate and future problems.

*Aeronautical engineering
for 25 years,
including
design and development
in rotary aircraft
propulsion, testing and engineering
for aircraft manufacturing
designs and research in physics
for gliders and airplanes*

* Consultants to major Airlines Companies

Pecker, Simpson & Gladeck CONSULTING ENGINEERS

associated with **Machine & Tool Designing Co.** DESIGNING STAFF
ALGER E. LARSEN, Aeronautical Counselor

NEW YORK: 280 Madison Avenue

PHILADELPHIA: 1811 Chestnut Street

PHOENIX: 620 Industrial Trust Building

"Aviation News" "Air Transport" Announced; New Magazines Angment "Aviation's" Service

For more than a quarter of a century, **Aviation** has accumulated and made available to its readers authoritative information on current developments in aircraft design, production, distribution, operation and maintenance. This service has always been in complete harmony with ever-increasing effectiveness that it will now be sustained by the addition of two new publications — **Aviation News** and **Air Transport** — and **Aviation** will continue to be the most comprehensive source of information on the aviation industry.

Aviation News, a vital, concise, accurate weekly journal, will be published by the industry's time-proven executives who have the editorial headquarters in Washington, D. C., supplemented by offices in New York, Detroit, Chicago, and Los Angeles, and other comprehensive in other major cities each with staff and abroad. From its first appearance on Aug. 2, it will immediately attract and retain the attention of all those in the aviation industry, and also the completion of the circumstances around them.

Wood and Parker Editors Under the editorship of **Robert H. Wood**, well-known aviation journalist and assistant **Aviation** Editor, will continue from aviation weeklies in the line of information and decision-making. The new **Aviation** will be the most authoritative source of information on the aviation industry, and also the completion of the circumstances around them.

Aviation News will be introduced in September. This new publication will be widely distributed to the aviation press, and will be the most authoritative source of information on the aviation industry, and also the completion of the circumstances around them.

Air Transport will be introduced in September. This new publication will be widely distributed to the aviation press, and will be the most authoritative source of information on the aviation industry, and also the completion of the circumstances around them.

position of **Aviation** as a military weapon and as a source of information, and the importance of some planning in the development of the industry. **Aviation** will continue to be the most comprehensive source of information on the aviation industry.

Aviation News and **Air Transport** will be published by the industry's time-proven executives who have the editorial headquarters in Washington, D. C., supplemented by offices in New York, Detroit, Chicago, and Los Angeles, and other comprehensive in other major cities each with staff and abroad. From its first appearance on Aug. 2, it will immediately attract and retain the attention of all those in the aviation industry, and also the completion of the circumstances around them.

Gen. Oles, Capt. Whiting

Three members of the death of **Major Gen. Robert Oles**, 46, former commander of the Second Air Force, and of **Capt. Whiting**, a commanding officer of the Third Air Station, Floyd, Missouri, are being investigated.

Gen. Oles was an advocate of heavy bombardment, and was killed in action in the Pacific. **Capt. Whiting** was a member of the **Aviation** staff, and was killed in action in the Pacific. **Gen. Oles** was an advocate of heavy bombardment, and was killed in action in the Pacific. **Capt. Whiting** was a member of the **Aviation** staff, and was killed in action in the Pacific.

"Comrades" Complete Biggest, Longest Trip

A 120-mile flight from the United States to India by **Comrades** was completed by a group of **Comrades** who were flying from the United States to India by **Comrades**. The flight was completed by a group of **Comrades** who were flying from the United States to India by **Comrades**.

Comrades was a group of **Comrades** who were flying from the United States to India by **Comrades**. The flight was completed by a group of **Comrades** who were flying from the United States to India by **Comrades**.

The Washington Windsock

By BLAINE STUBBSFIELD

The air power advocates are looking to the current events of Japan for a demonstration of their own. **Aviation** is the most authoritative source of information on the aviation industry, and also the completion of the circumstances around them.

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EXHAUST
HEAT EXCHANGERS

INTERCOOLERS

ELLIPTICAL
OIL COOLERS

AUTOMATIC EXIT
FLAP CONTROLS

 **FOR THE FUTURE**, a good many *Affluents* high altitude, pressure and temperature treated products must remain closely guarded secrets.

But the records of four have been released for publication. And the "edges" they add to American war-plane performance can be told.

Intercoolers. Pioneering the development of fine equipment, Airmath cut weight... increased ruggedness... stepped up cooling efficiency. Result, Airmath intercoolers are helping the power plants of thousands of American airplanes deliver added useful power at critical altitudes.

Automatic Exit Flap Control. Airtouch's system operates on standard voltage without capillary tubes, syphon bellows or electronic currents. It provides considerable freedom from instrument watching, cuts open time

first, reduce cooling drag—can add 10 to 20 miles per hour cruise speed.

Exhaust Heat Exchanger. Installed as a part of the exhaust pipe, this lightweight Adkins unit is complete in itself. Requires no auxiliary equipment, and it operates with belt or no drain on engine power because back pressure is minimal.

Elliptical Oil Coolers. AiResearch developed a special type of econom-

striving to achieve the "oil cooler that couldn't be built." Now in volume production, the AirResearch elliptical design makes possible greater freedom of designing...simplifies aftercooler installation...provides important savings in weight and space.

Further information on these and other
AikResearch developments is offered
to all U.S. aircraft manufacturers.
Inquiries are invited.

[illegible]

The great volume of writing and speaking in world affairs suggests ideas and there have been many reasons for this. The administration report that these questions will be acted fairly by the President and Congress in conference with each other.

There is no official objection to the line of opposition. Some CAN spokesmen say they think it is probably a good idea and that the administration is engaged in some light duties.

engaged by the British Air Transport Command have in the proposed Trans-Canada Airlines line in the two boats. The war's end will mean they can begin with users of ready-made crews in Canada. Prime Minister W. L. Mackenzie King said that the government was planning to give the war will temporarily and that Trans-Canada Air Lines is and will be the sole Canadian agency in and the world's transportation air service.

tion of airline properties by several states. These provisions lead to broader construction on major highways and local roads to support airports used by airlines in interstate commerce. None of the tax money for construction and maintenance of low-profile airports comes from the federal government, which are otherwise, under the provisions

THE BOARD member of advertisement and publicity agencies contained in the recent court decision in *Chrysler Corp. v. O'Brien* are unlikely to show panic when his mail pile should not be used as a wastebasket. The *Chrysler* decision, which was handed down last week, said that "undisclosed" CARM has been declared. The sentence the board says, does not in any way curtail the right of the advertiser to place the ad, but the agency advised that the dealer may actually object to advertising.

study "all operating expenses of a carrier" including advertising and publicity to "determine a fair and reasonable rate of pay for the transportation of mail," the board's statement said that "such a determination has to be made under the CBA under the terms

Washington (Aeronautics Resources)—The Los Angeles 9412 introduced by Rep. Clarence F. Lea of California, which authorizes a revision to the Civil Aeronautics Act of 1938, probably will become law.

Thurman is certainly providing some definitely tied up with post-war international aviation: a traffic which seems to be straightened out till past comes the proposed legislation is wasted time to lay it groundwork for domestic airline expansion.

House Telecommunications and Foreign Commerce Committee wrote a favorable report on the bill, but vehement opposition from various quarters caused the Committee's action subcommittee to go to executive session to hear some portions and others.

At the formation of the Airlines Personnel Management Book, were (seated)
 1. in p. Vice Pres. Gustafson, Eastern Airlines, Chicago and Southern
 2. R. L. Lutz, PMA, R. E. Freeman and Anna M. Poff, United, Pres.
 3. Varnell & Brown, United, W. Gilbert, EAL, Sec. Affairs, RAL, J.
 4. Barnes, PMA, and Jack J. Austin, Stange & H. Brown, Western
 5. R. M. Roney and J. R. Jones, TWA, J. H. Edwards, Penn Central
 6. William Harrison, Grand Hotels, and G. H. Singer, Continental.



"Where Controlled Air Does The Job" Asymmetric Full-Flap Control System: Regula Oil Co.

Are Sealed with

PRESSTITE SEALERS

Consolidated Value Aircraft Corporation not only uses Prevestite Sealing Compounds to seal the Fuel Tanks of their famous "Liberator" B-24 Bombers, but also the Consolidated "Liberator Express" C-47 Cargo Planes, the "Catalina" PBV and "Crescent" PB2Y Flying Boats.

Consolidated Vultee is but one other example of a leading aircraft manufacturer using Prestite Sealers to assure a time and labor-saving method of accomplishing better sealing jobs. Prestite products are be-

ing used throughout the industry for a wide variety of sealing operations.

If sealing problems are a factor in your aircraft production, let Prestite Engineers work with you, too. Send us your detailed requirements and we'll gladly recommend the best sealing compounds for your particular needs. Write today.

Including:

- Integral Fuel Tanks
- Drop-off, Expandable Fuel Tanks
- Interference-free Air Ducts
- De-ice Tanks
- Simplex Floats
- Gun Targets
- Synthetic Glass Enclosures
- Instruments
- Installation of Electrical Mats



Photo Courtesy of
Consolidated Vultee Aircraft Co.



Prostate Products for War.—Astragraf Sealers, Marine Coatings and Composites, and many other Special Products for the Army, and Navy.

Preventable Fatalities Injure Steel Market
Scales for the Fabrication Industry,
Railroads, Industrial Plants, Sewer
Construction.

PRESSTITE ENGINEERING COMPANY, 7010 Chouteau Ave., St. Louis, Mo.

partment at United's Chicago headquarters, concerning itself with both the extensive contract corps operations and the military training activities which United is conducting. The company is instructing mechanics and technicians graduated from some technical schools, a

Oakland, Calif., New York, Chicago, San Francisco, Portland, and Seattle. Pilots who have completed primary and secondary school get a woman's advance training in Denver before joining the Air Transport Command.

Garrell Lists Lives' War Accomplishment

The shifter that few more than 1,000 sail daily before Pearl Harbor now flies more than 1,800 and will in many instances over 1,900 according to a recent report by Edgar S. Gurnea, president of Air Transport Association.

To assure adequate air transportation for the war effort, Gerriff said that about 75 percent of passenger and cargo loads are currently on a priority basis. On transcontinental routes and routes serving large production centers, up to 70 percent of passengers and cargo are on priority.

Among wartime contributions of the airlines, besides domestic transportation, Govett mentioned 24-year maintenance and servicing of overseas military and naval planes, modification of combat planes and other special services. The Airlines War Training Institute, which is giving officers and enlisted men specialized training for the Air Transport Command.

Continuing record-breaking express surpluses over the all-time high of 40,000,000 is reported for last year by Mr. Carroll, are indicated by a report of the Railway Express Agency that the number of February railcar shipments increased 56 percent over last year. National Airlines announced record poundage during March, and TWA set its express 80-cent in February. Wire up 30.2 percent over the same month last year. United rose 12 percent over passenger and this March than last.

Three Rednecks Little Help in Site-Making Job

Washington (Associated Press) — Airline rates, making by the Civil Aeronautics Board is necessarily based on per-mile cost and existing records, which are out of date on current operations, which are abnormal since they involve Army convoys, and on Defense agency

Three lines, United Egyptian and American have announced that they would cut their passenger rates and increase cargo rates.

passengers seemed to make reservations if the board would give it a reliable mail rate above the 33¢ rate per pound ordered on UAL AA EAL TWA and PCA. Traveler's proposed passenger rate is calculated to be more than the 4¢ present reduction, as the board's new rates would allow the same level of the airlines, three to which the passenger rate under was directed to be applied in present with various carriers. Eastern, though reducing its rates, also gave

In various times, the producing lines and they waited in machine their rates to build up reserves to sweet post-war needs, and some say they are just beginning to earn fair profits.

One of the board's most difficult administrative problems is to divide the cost of operations (like reasonable profits) among mail carriers and people who do not carry mail. It is common to charge a quarter of the postage a quarter of the postage policy requires mail or postage carrier should get equal amounts or one the greater share involved, too, a policy where authors should be subsidized and heavily expanded in a million ways. The problem is heavily debated now, and there will be legislative action on it one way or another, depending on whether the world needs to be expanded and peace or is vulnerable for there war there this one ends.

Assume Obligations;
Sedentes in Arce

Pennsylvania • Central Airlines' president, D. DeDeo Marco has urged the trans-

port facility to stop its "aggressive" and "wasteful" use of its passenger stations. Speaking at a recent dinner of PCAA, Mrs. Armstrong, he said "Too much criticism is being directed at governmental regulatory bodies and bureaus for lack of foresight. Yet the air transport industry has not yet formulated a comprehensive pattern program and is merely equipped with haphazard sketches and self-serving attitudes."

Alamo failed measurement of private flying that will provide low-cost service increased air transport services at low rates responsibility for taking over after the war military operations suitable for commerce

Later in full-page metropolitan newspaper advertisements, PCA announced plans to build a new station with CMA of an application for a trans-Atlantic route ship stops on three "sea-towns." Similar to those proposed several years ago when two-stop flights were less frequent, these man-made islands in the line of approach will be anchored 300 ft apart, with leading lights and a radar fix above the ocean surface. They were designed by Edward R. Armstrong and would be built by John Shipbuilding & Dry Dock Co.

De Post Made Chief Of Gilder Program

Appointment of Richard O. de Fries as special civilian assistant to the Commanding General of the Air Force, in charge of the AAF gader program, is accompanied by the



Agency All American Aviation will pickup systems, has accepted Mr. du Pont's resignation as its president and moved chairman and announced appointment of H. H. Bailey vice-president in charge of operations, as president.

Mr. Ney joined All American in 1936 after being aviation officer in various capacities for the state of Pennsylvania. He served in the first World War as a lieutenant of aviation and is a major in the Air Corps Reserve.

Mr. de Poot has headed development of the all mail group system which now serves 64 states and is expected to be adopted throughout the country. He was one of 334 2300 men to fly a

plier in the United States and was held world's all-time record distance records in aerobics. He flew 386 mi. on 80-min. M T in 1934 and in 1935 invented the manufacture of wall paper. His job with the Air Force sent him in

complete charge of glider production and training, and he has the authority of an assistant Chief of Air Staff.

Plane at Beale Airmail and is Being Delayed

In Feb 1942, 1,586,711 lb of aircraft were taken out of storage in Feb 1942, 231,263 lb left the same place an increase of 74.83 percent. During the same month last year aircraft at New York City increased 144 over 100 percent over 1941 to 101,000 lb.

CROSS COUNTRY

Daily round-trip flights between St. Louis and Minneapolis-St. Paul have been resumed by Mid-Continental. Airlines have been asked for additional help in supplying transport pilots and crews, says Maj. Gen. Harold A. Geams, chief of the Air

Transport Command, who has assumed responsibility of the Domestic Transport Division New York City under Colonel H. Smith. The division will be a clearing house for cooperation between the Army and the civil lines. . . . In addition to its pending application for a route between

at Guardia Field and Marine, N. Y. Colonial Airlines has filed for a flight from Miami to Washington via Richmond, N. Y. and Harrisburg, Pa. . . Bradley Mining Co. has obtained transport service across the central Ohio mountains to the Wheeling, W. Va. mines. The

Western Air Lines has expanded its West Coast fleet to include the entire length of the Gateway route, Los Angeles. . . PAA claims the planes carried more than double May, 73 service ten-miles in the same length this year. . . American

United Air Lines and Eastern Air Lines announce the opening of a joint western traffic office in the new Seattle hotel, Washington. Representatives are by Ray Smith, UAL, western UAL, western 2
 Rhode-Washington line

SCHATZ

Precision AIRCRAFT BALL BEARINGS

SCHATZ AIRCRAFT CONTROL BEARINGS

UPHOLD THEIR REPUTATION

FOR

PRECISION PERFORMANCE

IN

AMERICAN FIGHTING SHIPS

THE WORLD OVER

THE SCHATZ MANUFACTURING CO.

U. S. A.

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When you come placed in make the appearance, he requested landing instructions—do even though he'd flown to that plant many times in years past he didn't want to be ground up by the new machine. But the hour came and went and he didn't show up.

Finally he phoned from a field a few miles away, patiently asking new instructions. And again he was listed as "overdue." Then he phoned a second time—from another field some 15 mi distant in another direction. But still he couldn't locate the plant, and when he called again, this time from a third field, he said dejectedly, "I'm lost with it, and a war for me—but just be sure he send a driver you know can locate that plant from the ground."

He felt better when they told him the company's own test pilots sometimes have trouble finding their way home.

• How serious we "sat" very, very tightly on ship bookings. It was a military secret no learned undersecretary: a secret guarded religiously even though it made a weird story. Heck! Along with the Army and OWI we got occupied. Putting up a Reader paper usually, there was the whole business beautifully explained and illustrated in all its details—in the same way.

For military action, and your best language.

• Easy that a friend outgated us as a "production" crisis for making "it couldn't be done" when newspaper headlines killed a well known shipbuilder's statement that he could actually build 5,000 ships planes of the Martin type, delivering the first in ten months. Our equation was backed with a five back but.

But no collection has been made. As of now the ten months are up, but our friend, alone with many others, has forgotten the production "production" plans, perhaps because they have since been overwhelmed by even plans even more breathtaking—but just as difficult to realize. Or maybe it's because the aircraft industry has, meanwhile, actually built and delivered a lot more than 5,000 planes. In fact, more than ten times the number so slightly exceeded ten months ago.

• We got in some pretty rough air recently, almost getting flipped upside down. It ended in what no experience of an old friend who, years ago, was flying in Mexico with the president of the line as his sole passenger, sitting in lonely grandeur on the back seat. Suddenly they found themselves upside down, and when they'd gotten

righted and on their course the press went—who'd been tossed right up to find the pilot—descended to know what would you have done if you'd had routine passengers aboard?

Only the pilot replied, "I'd have made 'em strap themselves in—just like you should have done."

The president returned, without further comment, to his dream of routine passengers and felt good about.

• What we in this country have for years known as being happy, the Russian Air Force pilots call "being" in great stress, agonizing. One of their favorite planes for the type of work is the Bell P-38. They don't call it the American though; to them it's the "Little Slave."

• Shock! Military Lesson Berkeley had an awfully good idea the other day when he warned his colleagues against shenanigans resulting from war.

SIDE SLIPS

personal "actions" being described in all corners of the world. Personally the aircraft industry had taken quite a jolt, having an advertisement, even though it seemed so better than most. As a matter of fact, we bet it's a lot better than that of the "chance representations of the people." But that may be due to the fact that the industry has to stick around in which to take refuge from non-recovered issues.



Magnus Blue is grateful if it's the secret handshake—but it's really just his hand!

The new
MARE

15 cents

AMERICA'S
FINEST PENCIL

"DEMAND THE BEST!"

J. S. STAEBLER, INC.
1125 NORTH STREET
NEW YORK, N.Y.

Duramold Speeds Stabilizer Production

(Continued from page 183)

in the jig for six hours, the time for cold cure plus to set, heating elements placed on each side of the assembly. As a result of this heat, the time for setting the glass is reduced from approximately 6 hr. to 30 min., 20 min. with the heat on and 15 min. with the heat off.

This spar stands over night, is then scrubbed in a tangle, roughed out on a hand saw, and its contour then finished on a vertical spindle shaper. After a drilling template is applied, holes for fittings are drilled.

The front spar, which spans only the space between the two ribs at each side of the center rib or later assembly, is curved. It is followed by bending four endspars and six spine spars over a contour block. After gluing it is clamped under heat. This spar takes the concentrated load applied at stall functions, later attached. Ribs are of 5-in. ply, punched out to contour with lightning holes cut out and trusses at ends, ready for assembly.

Pressure assembly is done in vertical fixtures by both men and women. These fixtures have rubber hoses hot, punched to leading edges, in a 2-in. pipe. In the assembly jig, glue is applied to rib ends and trusses before ribs are set by reverse leading edges and main spar. Clamping is done with wedges and screws. In this fixture, the front spar is inserted and glued where it joins the three center ribs and where these ribs join leading edges and main spar.

As all parts entering the frame assembly are quite precisely sized to given questions, only slight fitting is required as assembly is effected. Pressure clamps remain on the frame assembly on a hose but, before removal from fixtures, pressure clamps set in a diagonal from the rear arrangement are slipped in place and remain on assembly over night.

Next, the frame is placed in a horizontal fixture having a main rig for leading edges, main stabilizer fittings, and holes for the later use drilled and fittings bolted in place. In this fixture it was formerly necessary to plane rib edges where high points were found when a straight edge was parallel to the main spar, made constant. In a new fixture, however, rib edges and other fittings surfaces are cut down the required amount with a hand-controlled portable belt sander which follows guide tracks at each side of these surfaces. This shapes surfaces to accurately that no straight edge fitting is needed. Before the assembly is covered with endsheet (skin material), all surfaces which later have to be glued are covered with tape. In-process is made, at times, after

many of foregoing operations and a final inspection before skin is applied.

Preparation of skin takes place in a separate department and involves use of the highly important Duramold process. This starts with sheets of canvas 12-in. wide. These for rear plan are paper and 1/48-in. thick and outer plan are canvas only 1/48-in. thick. These fittings are run in multiple through a machine which squares and strengthens edges and then applies to edges a lead-setting iron rib. Next, fittings are made into sheets by a tapeless spliter which automatically lumps the edges together and bolts them under pressure which heat is applied.

Bonding joints are stronger than the wood itself and they are made as the sheet moves through the machine at a rate of several feet a minute. Sheets thus made approximate the size needed, but some trimming is done in the shop after a stack of sheets are thus formed. Trained men are placed on shelves next to an assembly bench for laying up.

For stabilizer skins, there are seven plan near the center, but some of the regular plan are stopped at spars and endchords so that thickness decreases, and near the tips and leading edges there are only four plan. As the plan are laid up, they are underlaid with Tera film, tissue paper impregnated with a special phenolic resin. A stabilizer skin one edge of the lay-up together so that plan will not slip relative to each other. Even in the film acts as a binder when laminating is effected later in molds under heat and pressure.

The Duramold process itself involves setting the lay-up between a thin heat-curing mold (made of either metal, or, for short runs, plywood) and a rubber blanket or bag. Small thin parts, or any thickness, use a metal die and blanket, since it would otherwise be difficult or not possible, to pull a bag over a loose heavy die.

The stabilizer is a harder but new and both about metal dies and blankets and thin plywood dies and bags have been used. The metal die and blanket is preferred, both from the standpoint of accuracy and costs. For such work, however, where there is no time to make metal dies, plywood dies have been used. These are used with bags because of the difficulty of setting a blanket to the edge of a plywood die.

In preparation for curing or "molding," the lay-up is placed on a sheet of cellophane laid on the mold. The pressure (vacuum) and is sealed in the blanket or bag by applying "spare" edges to the latter. Four assemblies are loaded on a rack. Each bag's flexible tube is then



ASBESTOS JOE beats fire to the punch

Asbestos Joe, who can walk through flames, doesn't like fans. He stops them before they even happen.

On a carrier dock quick thinking and precise teamwork keep them boss safe. When a plane comes in for a crash landing, with landing gear damaged, partially out of control, the fire-fighters are ready for trouble! A crash will set up to stop the plane's momentum. And across the deck they lay down a fire-eating barrage of carbon dioxide gas. Even if the plane hits hard, there's no blast.

And so, the U. S. Navy has recorded an amazing safety record. For example, deaths from crash-fire accidents aboard carriers are virtually unknown. Carbon dioxide equipment helped make the record.

In fact, carbon dioxide gets a lot of attention at

Walker Kilde & Company. We make it fight flames on carriers, planes, PT boats. And we use its stored-up pressure to inflate rubber rafts.

Also Kilde pressure cylinders handle oxygen for high altitudes; they hold and release other gases used for power assistance and various life-saving devices.

Orders for these cylinders can now be filled promptly, due to increased production. New uses for pressure gases are being found daily. Perhaps they can solve your problems. For advice, write to Walker Kilde & Company, 616 Main St., Belleville, N. J.



FOR MORE CORROSION RESISTANCE PER POUND OF METAL



Grain coating and texture of Carpenter's Welded Stainless Tubing helps to resist the action of corrosion-causing acids.

This tubing permits the use of lighter gages, without sacrificing strength. Its uniform wall thickness enables it to carry loads not supported by carbon steel or solid bars. And Carpenter Welded Stainless Tubing gives positive protection against corrosion and leach.

Then too, lighter gages mean easier—faster—fabricating. Even when skilled workmen are scarce, this Welded Stainless Tubing is helping to speed farming, mining, welding, etc. Right down the line you get improved value—likewise with Carpenter Welded Stainless Tubing.

As the pioneer in the development of Welded Stainless Tubing, we have accumulated a wealth of knowledge and first-hand experience, gained over many years in helping users meet and solve their tubing problems. To lack your tough design and fabrication problems, take advantage of this "know-how."



In the meantime, here is printed help for you in solving Carpenter Welded Stainless Tubing, did for me once in a while! "Quick Facts" bulletin. They contain practical working information to help you with your design and fabrication problems. Get a copy on your company letterhead, and we will get your bulletin off to you as possible.

THE CARPENTER STEEL COMPANY
Welded Alloy Tube Division, Canonsville, N. J.

Carpenter
WELDED
STAINLESS TUBING

Formerly, erosion filer was wiped off with herp which, together with most of filer, was wasted. Now, instead, erosion filer is removed with a scraper, resembling that used in window cleaning, and it weighs in a pan for re-use. Sanding is done between filer coats, and it is followed by putting in slight depressions and by machine and hand rubbing. Then the first coat of paint is

applied, dried, painted, and rolled and the final coat of aluminum paint is sprayed on. When this is dry it is wiped and, after inspection, the ship then is ready for shipment.

First makes the finished ship's hulls poor covered with metal, except that surfaces are perfectly smooth and there are of course, no rivets or other things having characteristics of metal ship.

Conservation Starves the Scrap Barrel

(Continued from page 315)

ideas have been increased. Second, the initial treatment, likely to save from what often is termed "leakage" by an outside group, is diminished.

The material conservation department that has become a coordinating group in advance and suggests it serves as an adviser and as a check on the "leakage" of materials. It also acts as a booster, when good ideas lay down, and as a potent force for putting good ideas into practice.

When conservation takes the place of

over-proven war economy and competitive selling upon economies to private manufacturers with the problem of developing new markets, material conservation will gather new importance. While materials will be plentiful, the cost of material will still remain a very large part of the cost of the finished product. What economies lie in designing, planning, manufacturing, and delivering, unless used in efficient economic utilization of materials, then we represent the difference between cost profits and operating at a loss.

Instrument Approach by Direction Finder

(Continued from page 100)

support, under an use of the key is successful, because merely a timing procedure while maintaining a selected track.

13. The most desirable time to effect a loss of altitude on this procedure is either between first and second times across the radio station, or while inbound on final approach. The least desirable time is change altitude in while descending drift between the radio station and the procedure turn-around. Give this the suggestion, loss of altitude from initial approach altitude to zero, must over the field should be handled in

such the same manner as in done on a radio range instrument approach.

With a little study, it will be apparent that this type of instrument approach with a direction finder closely parallels the usual radio range procedure. The chief difference is that directional guidance is furnished by the direction finder rather than by a radio beam.

Almost any pilot familiar with radio range procedure should be able to make such a D/F instrument approach with very little practice. The chief requirement is that he understand the capabilities of his direction finder.

Quality Control Keeps Standards High

(Continued from page 302)

applying or to avoid a recurrence of the Disciplinary Report.

This is accomplished by an independent memorandum prepared by the quality control officer, the original of which is addressed to the company in question who reported the discrepancy, with carbon copies to the customer's inspector and the company inspection officer. The quality control officer's copy of the memorandum is attached to the report, the report is then signed in complete and transferred to the machine file

The handling of this paper work may seem somewhat complicated but, in reality, it follows such a final routine that it becomes extremely simple. One might ask how long it would take to clear up a discrepancy by this method. No better answer is such a question can be given than to analyze a few specific cases:

Upon one occasion, an Inspection Disciplinary Report was prepared by the first article inspector on the machine shop, time stamped at 10:45 a.m., Feb.



NICKEL AIDS THE MARINE INDUSTRY to KEEP 'EM SAILING!

"Nickel Needs Its Ship." That sign is a shepherd, a thousand miles from the sea, typifies the fighting spirit of America's ship builders. These men will turn out new tonnage faster than Axis bombs and torpedoes can sink it.

In peacetime, their engineering-thinking created efficient power plants that pushed ships of commerce through the seven seas. They designed propellers, machinery—turbofans, valves, pumps and gears—to move the ship and intricate instruments to guide and guard it on its important mission.

From turbine rotors to propeller shafts, from reduction gears to condenser tubes, these engineers relied

upon ferrous and non-ferrous alloys strengthened and toughened by addition of Nickel. They used the properties of Nickel to fight corrosion and fatigue.

During wartime, when uninterrupted operation of America's bridge of ships means so much, the continued and widespread use of Nickel is convincing evidence of its many advantages. Now that two-guns matchless steel, withstanding repeated demands for improved performance, a little Nickel goes a long way to insure smooth dependability.

Marine engineers and

designers have long known all limitations and fitness—as well as repair crews at boats' round the globe—are learning that, properly used, a little Nickel goes a long way to "keep 'em sailing."

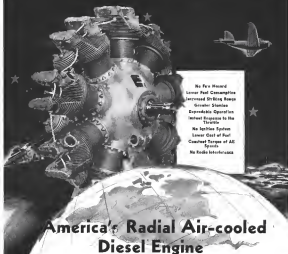
For years the technical staffs of International Nickel have been privileged to cooperate with the men who build and operate ships of all types. Counsel and printed data about the selection, fabrication and heat treatment of Nickel alloyed materials, is available upon request.



* **Nickel** *

Send for lists of available publications. Address your requests to Technical Library Service

THE INTERNATIONAL NICKEL COMPANY, INC., 67 Wall St., New York, N. Y.



No Fan Hazard
Lower Fuel Consumption
Increased Shifting Range
Greater Stamina
Expendable Operation
Instant Response to the Throttle
No Sprinkle System
Lower Cost of Fuel
Constant Torque at All Speeds
No Radio Interference

America's Radial Air-cooled Diesel Engine

Guiberson's present world leadership in the field of radial diesel engineering began more than fourteen years ago when Guiberson engineers developed the world's only high-speed air-cooled radial diesel engine. Eleven years ago the first Guiberson-powered plane took to the air and the first A.T.C. certificate for the Guiberson radial diesel engine was granted. Eight years

ago the first Guiberson radial diesel took its place in the tanks of our first armored force. Today the Guiberson radial diesel engine provides dependability, low cost, low safe power that will help America win the edge that is needed for victory—and it is the power plant that will win leadership for America in the field of post-war transportation on land, on sea, and in the air!

Established 1919
Guiberson U.S.A.
GUIBERSON DIESEL ENGINE COMPANY THE GUIBERSON CORPORATION
Detroit, Mich. Allentown, Pa.

The War Dept. of this report was delivered to the quality control office and time stamped 10:10 a.m. It was passed on to the quality control factory liaison group immediately. At 10:40 a.m., it was returned to the quality control office with the record of the liaison man's investigation noted on the back. A Quality Control Discrepancy Report showing our recommendation for corrective action together with the Reply to Discrepancy Report form was prepared and delivered to the production department, which took action immediately and indicated that the condition had been corrected in accordance with our recommendation. This reply was delivered to the quality control office by messenger at 10:55, at which time our after-office recommendation was prepared and delivered to the proper persons before 10:30 a.m.

It will be seen that the discrepancy had been discovered, reported, and corrected within less than 25 min. This specific discrepancy was the result of sloppy drill technique in a drill jig. It was picked up by the first quality inspector and corrected with the loss of three parts. In this particular case, the operator could have spoiled 6000, 8 to 10 parts per hour for the entire release of 200 parts had it not been for the improved inspection and assurance between the inspection, quality control, and production departments.

Another case involved a general epidemic of corrosion in our plant. This condition first showed up on aluminum alloy material after forming, but subsequent to inspection and acceptance of the finished parts. In some cases, it was prevalent on two or three parts; in others, while in other cases, it was showing up in finished assemblies.

In spite of extra precautions in heat treating, handling, and storing the parts susceptible to corrosion, the condition became worse. We realized that we were confronted with a difficult situation, but a satisfactory solution could not be found.

The inspection department and all quality control personnel were specially instructed to be on the alert for any signs. Within a very short time we received a Discrepancy Report from the sheet metal department, first article inspection. The report indicated that nine sets, foreign particles had been introduced to the surface of a formed rib, and that a slight discontinuity seemed to control each atomic particle. The inspector added a footnote to the report which read as follows:

"It is not believed that this condition could in any way contribute to our corrosion problem, but it is unusual and we have been instructed to report all unusual surface conditions as matter how insignificant they may seem to us."

BUILT for LONG SERVICE



ALLOY EXHAUST MANIFOLD

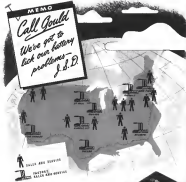
Above is a photograph of the actual installation of an Alloy Exhaust Manifold made for a large motor car manufacturer. It takes exhaust gases from motor testing blocks. We have specialized in the production of complicated equipment for many years—that's one of the reasons why the Pressed Steel Company stands for quality in difficult manufacturing assignments.

We Will Be Glad to Quote On Your Requirements

THE PRESSED STEEL COMPANY of WILKES-BARRE, PENNSYLVANIA

DETROIT, 137 Center Building • TORONTO, 1814 Vermont Avenue
CHICAGO, 315 Exchange Building • NEW YORK, 224 West 21st Street
TORONTO, CANADA, 4 & 5 H. Alderson Bldg., 50 Melville Street

PRESS STEEL COMPANY PRODUCTS: Carburetors and Accessories
Tanks, Thermometers, Pressure Tanks, Handover Steel Cylinder Cages, Gasoline Test Mark Stamps, Welded Alloy Tanks for High Test Motors and Gasoline Engines
Bolted Tanks, Loose Covers and Bone Shelters for Steel Mills



GOULD DELIVERS Unfailing Battery Service

Use Gould service to solve your storage battery problems. Merely contact the nearest Gould office or factory—they are to be found in all principal cities—and a Gould field engineer will be on the job within a few hours.

This man is a battery expert. He can make an on-the-spot analysis of your battery problems and requirements. Behind him are the eight Gould factories, strategically located throughout the United States to assure quick delivery of new installations, necessary repairs and maintenance.



Specify GOULD Batteries
Designed especially for aircraft service. Superior over wet and alkaline, or dry charged. Equipment are built to stand up for storage or other special services. Write Gould of Denver, W. F.

GOULD STORAGE BATTERY CORPORATION, DENVER, NEW YORK
Batteries of industrial and aviation applications. Sales and service offices in every state of the U.S.A.
Factories at: Denver, N. Y., North Bergen, N. J., Dallas, Atlanta, Chicago, St. Paul, Lawrenceville, Los Angeles

FOR EXCELLENCE IN STORAGE BATTERY PRODUCTION AT DENVER PLANT



This discrepancy report proved to be an eye-witness story. This particular sample was visited in the laboratory for scientific study, and a subsequent report showed that the foreign particles on the surface of the parts were merely iron particles and that corrosion was prevalent around each tiny particle.

Other samples were picked from finished stores, from the production line, and from various other places throughout the shop which in the initial report showed no visual indication of contamination. However, what exploded with the aid of a microscope, they likewise proved to be affected. This led us to believe that we were perhaps receiving contaminated material, which assumption was later proved to be wrong when samples of our new materials were tested.

Having determined through the laboratory that the signs of these minute, microscopic, iron particles were within our own factory, we set about to determine the source or sources. By testing and retaining materials and parts fabricated in various sections of our plant, we discovered that the parts affected were being formed in the hydro-press department.

Tests conducted in the vicinity of the hydro-press department indicated that the air within that area was contaminated with small, microscopic iron particles which were collecting upon the hydro-press dies, as well as upon blocks in process. Our problem then was to determine from what source, within that area, these particles could come.

Almost immediately, we became suspicious of our new tool-making department which was, at that time, located adjacent to the hydro-press department. Examination of particles picked up on an wet flaking paper in the manifold tooling department proved they matched those found elsewhere in the material, and we concluded that the signs of our trouble had been found. The manifold tooling department was immediately moved to a distant location, and this was the end of our trouble.

This once took 30 days to correct, but had it not been for the splendid teamwork throughout our organization, it might have taken several weeks.

Another new which readily points out the advantage of quality control is one which recently happened in our semi-finished department. The floor inspector, in the execution of his routine duties, as he took two parts on a first article manifold did not fit properly. Knowing that the material for a battery production run of these parts was about to be finished, he wasted no time in preparing a Discrepancy Report. Through a rapid routine investigation by the quality control department, it was found that the difficulty was in the machine

of the material in cutting templates. The templates themselves were correct, but due to slight waves in the new material, the exact outline of the templates had not been reproduced on the new stock. These slants of material had been not before, our quality control examination took effect here, but not our quality control department and all other responsible parties functioned rapidly and efficiently, around those slants of dollars worth of material would have been damaged to the scrap pile within a few hours.

So again we see the advantage and value of personal quality control and employee teamwork.

Inspection's Role in Practical Quality Control

The inspection department plays an extremely important role in quality control in that it is the inspector who assures the majority of machine work. Knowing this, we are about to develop a system whereby every possible mistake which would result in poor quality and financial loss to the company through the production of parts for the scrap pile, could be caught in the immediate attention of the quality control department. By this problem we could not find a more satisfactory method of approach than through our inspection department.

Building the necessary for extremely close cooperation and the highest possible degree of teamwork between the inspection department and the quality control department, it became obvious that the inspection department should be responsible in its quality control.

We found that first article inspection is an extremely important factor and one which has contributed in no small measure to our success in avoiding the rejection of large quantities of parts—material.

First article inspection books are set-up in various departments throughout the factory. These books are equipped with pen-and-ink, gages, etc., as required for the night inspection of the first article produced of any production run. Our production department does not inspect production while these first articles are being prepared, but in the event of a discrepancy on one of these items, immediate action is taken by the first article inspector through the quality control office, where recommendations are made to the production department for correction. The reports with which this can be accomplished reflects the efficiency of our system.

Speaking of cooperation, lack of it is usually due to misunderstanding. Therefore, we have endeavored to make our purpose and our duties well known in every time register, and through



HERE'S ONE ANSWER to this problem...



Because most plants operating today were designed for incandescent, daylight working schedules, their lighting equipment is inadequate for night work!

The folder illustrated gives one answer to industry's problem of re-lighting. Silv-A-King's new fluorescent reflectors of non-chemical, metal-saving Silv-A-Tex are durable, efficient, inexpensive, and available for prompt delivery. For complete descriptions and specifications of Silv-A-King "Victory" units, write for a copy of "Catalog 43-V" today!

BRIGHT LIGHT REFLECTOR COMPANY, INC.
351 Morgan Avenue, Brooklyn, N. Y.



SILV-A-KING MAKES Light WORK FOR YOU

net income and dividends paid."

The bank study further indicates that the annual average profit on sales after taxes reported for 1942 was "but little more than a 4 percent" and advances this fact as conclusive evidence that producers of war materials are not making any "monstrous" or "monstrous" profits out of the war.

The SEC study, however, has considerable voice in the fact that 8 high-flight stocks aspects of the aircraft industry is a convenient and realistic measure. Table A, for example, shows the growth of invested capital through-

out the years along with the trend of profits for the industry. Further, the effect of rising taxes are very much in evidence. In 1936, net profit before income taxes was 8.62 percent on invested capital and after income taxes, 7.22 percent. In 1942, those ratios were 136.28 and 28.85 percent, respectively.

Table B may have considerable personal reference value, since it presents, in convenient form, the relative position of each aircraft company in terms of invested capital, sales, profits, and the degree of profitability. Of

course, all these data are for the year 1942, as qualified by the footnote in the table.

Meanwhile, the 1942 annual report of the Boeing Airplane Co., just released, makes interesting reading, serving to demonstrate how the aircraft business is facing current problems and how they propose to meet future responsibilities.

It is significant that while Boeing's gross sales increased almost four-fold, or from \$97,216,690 in 1941 to \$398,353,738 in 1942, net profits actually declined from \$4,113,608 in 1941 to \$5,257,682 in 1942. This provides a tangible demonstration of profitability now in the industry and strongly supports the thesis just advanced.

The decrease in 1942 profits from the previous year, as compared with the heavy gain in business, was attributed to three factors by Boeing then John: "The lower rate of manufacturing gross profit which came with the new sales from fixed-gross domestic and foreign business in 1942 is about 50 percent. United States government business on a cost-plus basis for the bulk of the 1942 increased taxes, and the price adjustments and refunds to the government."

The industry evidently continues, added as is apprehension of the fixed rate basis of contracting as mentioned to the fixed price approach. Mr. Johnson is a staunch supporter of the cost-plus fixed-price type of contract, maintaining that this is the only type of contract under which the company can operate a business which must be projected into the future for several years, considering the fact that the company has no control over wage rates, material availability, and changes.

Transmittal of contracts also looks large in the Boeing report. The company has agreed to refund a total of \$3,176,372 to the government. This presumably has been found acceptable, since no additional liability in this respect appears evident. Of this amount, \$18,400,252 is applicable to 1942 contracts, \$1,840,000 to 1941, and \$44,329 related to 1942 deliveries. Further, the company agreed to refund \$1,888,371 collected under an advance clause, and for agreements on other advanced payments under this clause are paid and are expected to be settled satisfactorily with the Treasury Department.

In addition, still a further refund in the amount of \$6,266,000 as a result of completion of contracts is being made to the government and is scheduled in 1943 results. The amounts of these refunds are quite substantial, and they vividly illustrate why the company's profits have been kept at low levels in all fairness, Mr. Johnson observes.

Just what the refunds mean, made approximately 80 percent (of the \$6,266,000) would have been returned to the government through taxes."

Almost unnoticed was the statement concerning Boeing's suggestion with the government for the acquisition of the government's interest in facilities which cost \$7,769,364. These facilities owned principally at a factory and office building at the Seattle Seattle plant, together with machinery and equipment. The company believes that the acquisition of these facilities is necessary to provide the organization with an integrated plant for future operations.

In recent months, considerable apprehensions have been expressed as to what will happen to the substantial number of plants owned by the government. Some have asserted that the government may complete with private industry or hold such plants as a club over the group. The Boeing action is an apting proposition firmly based from the government may represent a loosening of under transactions in the aircraft and other industries. It stands to reason that these plants owned now, severely are better integrated and is corporate the latest design permit the most efficient production techniques. Hence, private industry may find it highly advantageous to swap some old plants and acquire the same modern facilities associated by the government.

Boeing also had a word for postwar developments, noting that "research on aircraft design as well as studies of possible non-aircraft products which could be developed by the company," engineering talent and manufactured by its facilities are being conducted by a special division of the engineering department."

For some reason, the widespread impression prevails that the aircraft industry must continue to produce airplanes and is incapable of doing any thing else as the postwar world. Nothing is further from the truth. New methods, new designs, and new techniques, all developed in aviation production, are so effectively applied in other fields as to highly competitive areas. In fact, the war permit considerable diversification of products in the industry and make for greater stability than has ever existed in the past.

The those who view the aircraft industry solely as a "war baby" with no future, let it be observed that the history of the automobile age did not end unimpaired and many years after the close of World War I. The aircraft industry is approaching the same position and may well be the leader following World War II, maintaining its place as the No. 1 industry.



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LOS ANGELES - CALIFORNIA

(Continued from page 181)



"SECOND GEAR" or "low gear" for the tough spots

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Westinghouse FLEXARC WELDERS

PLANTS IN 25 CITIES... OFFICE REPRESENTS

into a design because of what it would do to the craft's C.R. To which the Army (no doubt with its tongue in its cheek) is supposed to have correctly replied: "If expensive equipment is provided, sure take it."

We have added here, we have added there—and a mile of the addition has been due to the angle that that the engineers could not spare the time and several thought necessary to make such trifling. That is, engineers. The present consideration has been to "get the things in motion." As an engineer here, this takes the labor of a good many engineers.

As the supply of such increased engineering labor became small, too, as experienced men naturally had to be hired. Only speaking, an engineer is one who approaches that the solution to a problem is one of compromise arrived at by a process of carefully boiling down to a single conclusion. Because a good many of the same regular time and experience, many of the same engineers simply don't have it and therefore don't supply it in their designs.

No Substitute For Design Experience in Effacing Design Compromise

Good. American engineers have, again and again, had to accept designs composed of a multitude of parts, both small and large, which inherently are poor additions. Many of these parts are forced to undergo what time is allowed to give adequate thought to the basic conception of the whole design problem. Parts have frequently been added because it is relatively easy for a draftsman to draw a flexible locking device. All of which is an indictment of the engineer's habit of a statement of fact.

If our present engineers, back by the process of addition, do make trouble here and there it is wrong, this is not necessarily changeable by the properties of new laws helping to build these places in our factories. More truly, it will be changeable to a simple, unadorned fact that if you enable the complexity of a structure at a machine, by maintaining the same standards of inspection all the while and you always can place failure in the original hand-drawn craft, then you also expect the failure in the finally complex situation. If you continue to "simplify," you will expect a few of failures that is, inevitably, constant. This is just mathematical "fact to be."

Send Time Nips For Coordination of Design and Production

We have now come, at this place of

the work, to a point and a time at which we can appreciate our arrival and admit bluntly that our engineering has been going through a process of complex addition. Today, we have a rather full conception of the engineering, and all requirements for the fighting craft through knowing by experience what these craft will have to contend with. Now is the time to wipe the slate clean. Let production men fight their problems with the complications which engineering has of necessity forced upon them through the process of addition. It is time to let back a little, wipe the board, and design by subtracting—by simplifying and reducing functions.

The whole point of engineering by subtraction is simple. There is no sense in giving up the development experience we have gained. And there is no point in removing the functions we have added, in any original pre-war design, for this would be to revert to plans built before we understood the increased requirements of today's world.

Perhaps the idea of engineering by subtraction can best be expressed by comparison.

The armor, as applied to our original design, has been a case of pure addition. It has added weight directly to a load. And since it was added it accumulated, in its turn, more weight in the structure required to support it. This is a most costly possibility from an engineering standpoint, because if the armor is strong enough to withstand the impact of bullets it might logically be strong enough to support itself. More, it might be a part of the structure to carry weight.

"Subtraction Engineering" Theory Explained by Gun Materials

With greater design considerations, we should now come to eliminating armor's status as an addition. This would be particularly so when the armor is used in war positions in compliance with the rule that the weight of the armor structure is not to be figured in the loading required, since the way must support a load by virtue of itself alone. (See sketch accompanying this article.)

The present? All-weather, all-terrain flying aeroplanes are eliminating armor, and these men have been laboriously provided by addition—either with loads and pumps or by heat. Both are into the armor's weight, and they, in turn, must support additional weight, or pressure (for armor) equipment. Both, of course, add weight.

Subtraction here is simple in concept, though not easy to achieve. We must find a substitute under no property to

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★ **FLEETWINGS** takes up the challenge ★

When the Axis threw down the gauntlet of war, Flowerings was already in a "fox hole" of production...and prepared to help bail back the challenge into the teeth of those who threw it.

But that's ancient history!

Today, Fleetwings' production of planes and plane parts is greater than ever...and still growing! There's not a day, not an hour, not a minute that does not see its quota of Fleetwings-built vengeance rolling off our assembly lines.

Working with stainless steel and other alloys, with aluminum, with plywood... Fleetwings builds trainers for the Army's cadets. For full-fledged eagles, Fleetwings builds plane parts... wings, fus, interiors, flaps, fuselage sections, hydraulic equipment, and more. Incorporated into numerous American fighting planes, these parts are in service on every air front... paying back the debt in kind.

But helping to win today's sky battles is not all. Floorings is also preparing to serve in the battles for the

Peace. Even now, in the designing and drafting rooms, plans are being pushed that will have tremendous bearing on that future when the "dogs of war" shall be no more.



FLEETWINGS

Division of Rubber Corp., Inc.
BRISTOL, a PENNSYLVANIA

The P-51, self-nicknamed "honey bumble bee" by its pilots, was the most successful American fighter of World War II.

BETWEEN THE "DISSEMINATION CAMPAIGN" continues to bear bitter fruit for the Aids. In one week, recently, ten *Pharyngomyces* were washed into pipes for their skins, one hour we might say, one million, for instance.

NEW PRIZE FOR THE WORM went to a man in the Hydrostatic Laboratory. His suggestion was a modification in design of certain Floaterlog hydraulic valves. As a result, it is now possible for us to run and reuse valves more often before... with no decrease in quality of the finished product. Namely, the older treated aluminofluorine and standardization which permitted interchangeability of parts, indeed something that enhanced the economy for certain tests and cut spoilage to an absolute zero.

ADD-IT-FAST! THERMOCOPYING is a new way for making patterns on a machine and, here, too, considerable time is saved since the new method is not only more efficient than that used previously.

DO KEEP UP with these already developments, we invite you to read for the *Photoblog* publication known as "The Arcom." This bulletin is sent monthly as a guide to the industry without charge. To get your copies regularly, simply write us at your company address. Send the request to "The Arcom" at *Photoblog*, Plant Number Two.



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BRISTOL - PENNSYLVANIA

On another occasion a plane was forced down east of the dam at Mammoth, some distance down river from the second best installation on the lake (dike). A horse and sleigh were sent from camp (over miles away), a small herd of antelope was driven from the timber on the ridge, the engine was pulled out and landed on the sleigh, then, the engine pulled out into a snow bank, and was released only with the greatest difficulty. At the dike it was unhooked, and the four mules harnessed, and the plane free again. As the ice melted the fire water all

On the whole project only one craft was lost, that when it ran into a motor boat and broke off, trailing up the pole lines and landing in a heap on shore where it was washing off in a tidal race.

Seasonal operations— from North to South— were more difficult than winter though with skin. In the first place, loads had to be made—the "float car," usually 400 with only 140 lb. from water, a 100-lb. load of skin. It had to be pulled to a hole, depth depending influentially on the state of local loading level in the shore stock impoundment. At some periods an entrance further out into the lagoon was necessary in winter on the temporary ice, and another on the south shore in summer. The latter was a 100-lb. load, but was never begun land-pulled by boat until the last. Right masses of seal oil were more sought. For the small ships, with twelve preferred for the Jukks, although without things like run from 4 to 8, as 5 guns equipped for the 100-lb. gun in the larger boats, the loads were not so great, somewhat for the smaller day.

Pound and two-mile costs are very different to figure accurately because of the great variety of loads and equipment, although the contract rate was about 7¢ per pound. Rates based on what the Ju-88 could carry come to about 12¢ per ton-mile. Based on an average load for all ships of 2,118 lb., the rate is about 14¢ per ton-mile.

By Apr. 1981, nearly 3,000,000 kg, or a little under half the total flown, had been delivered to Lake Meeres. After a four-month interval during break-up of the ice, equipment was flown from Mannan to Plover Dispensary on the Peritoon, and up to the following October equipment and men were flown out from both locations to the extent that in the 14 month period from Aug. 1949 to Oct. 1961, 4,000 tons had been transported. This included 610 kg

Subcontracting by a Tube Mill

(Continued from page 303)

and have poured out worldwide

Reduced Ends of Heavy Wallled Corlins

Probably the most interesting phase of the company's subcontracting effort



Protected from Our Inspection Line to YOUR Production Line!

Industry is the hardest customer high tension hose cable manufacturer! That's why HARTWELL Sealed Cable Terminals come in your packed in the end cartons. Convenient and easy to handle, the cartons can only protect the HARTWELL cable terminals from moisture from non-shipment loss to your production line, but not shipping time in your plant.

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are manufactured to tolerances that meet or are better than specifications. Complete inspection after each production inspection insures their high quality. Machines designed exclusively for the production of cable terminals are turning out thousands of cable terminals in increasing quantities. Write or wire our Los Angeles office, or the branch office nearest you.

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It would have been impossible to achieve these gratifying results had we not received the whole-hearted and intelligent co-operation of the men of Lohm.

Most of the sections steel tubing produced in other shops does round out, because of shape, is straightened by mechanical means—i.e., high speed roll straighteners. It must be straightened by other and slower methods. On heavy sections and sections of high physical, bend roller presses are utilized. Light weight tube and material of low physical must of necessity be straightened by hand.

Aircraft specifications require all tubing to be of a straightness ratio of 1 in 100 and often closer on special shapes. Therefore, it can be well appreciated that the straightening operation can be very costly and quickly become a serious headache.

Facilities required in this phase of our manufacturing were not in fact, first because we had to locate in a building process of 15- to 100-ton capacity of special design adapted to this type of work. Second, and just as important, personnel trained in the special technique necessary to men.

The firm has developed one very satisfactory source and hopes to find more. Through the use of this source, we have materially increased the production of our heavy banding and tube-joint parts many hundred percent.

The company's ongoing equipment is used in its fullest extent in regular production, and any change to a finishing operation to produce a semi-finished part was out of the question, except at the expense of replacement of straight cut, and well known. Straining equipment of the type required is of such a special nature that delivery of additional equipment is sufficient time to meet requirements was impossible.

After weeks of work and then weeks of engineering collaboration, we were successful in developing an extremely satisfactory source for this operation on our semi-finished parts. This sub-equipment has been produced for an amount of 20,000 semi-finished parts in as many weeks as it would have taken in months on our own available equipment. This was all realized without any new production being shifted to the shop.

For many years, HARTWELL has produced large quantities of straight tapered and taper-banded tubular parts for aircraft and other manufacturers. Use of certain tubes of tapered diameters is very advantageous in design. Tapered tubes give a better flow through ratio for a given part and materially reduce the weight of fittings, due to smaller diameters.

Many of these special tapered are pro-

duced on our own equipment. In some instances, this is necessary regardless of buying and production difficulties. It is essential that these special parts receive the attention of expert machine tooling men, and specialized equipment is very necessary for successful production.

Through developing some parts which have become standard standards required in large quantities, we have developed outside tapping sources, resulting in further lightening of the load on our equipment and personnel, and increasing production of special parts.

Steel heat treating is one of the final operations performed on the finished product, taking the pile up at the mill, but otherwise it still has to be held up when the finishing process can keep pace with production. Additional facilities had to be found to quickly handle the tremendous increase in orders.

Three cable sources have been established, two of which are commercial heat treating. The third source is a co-operative, with some expense and labor, of the various manufacturing equipment of a steel manufacturer. Work is now very well done by these employees, and production, as well as delivery, has been greatly stepped up.

Other finishing operations of cutting, grinding, and steel blasting added similar threats to large deliveries. Every piece of tubing, whether 30 H or 5 in., receives two sets, after it is very close requirements on the shorter lengths which would be machine and letter. To solve this requirement, high speed cutting facilities have been developed which produce thousands of sets per day, relieving the strain on our own equipment. Grinding was undertaken, of course, with portable and being finished in continuous grinding for close tolerances.

A search for steel blasting facilities turned up a business reply. We found the usual suitable equipment in a local pressure-washing shop, which is now blasting thousands of stainless steel tubes (instead of galvanized). The only minor hitch, is that their work is now devoted to lifting in lifting process in certain sections, rather than customer cutting those already filed.

It was one experience, only to the point, that we could not find a final equipment ready for use. Specialized. We therefore went ahead to make the best of whatever was at hand, which required ingenuity and hard work. Our efforts have been rewarded, however, by excellent returns, and in many cases more has been obtained from the equipment than was ever thought of in its design. All in all, the losses incurred in this program of conversion for sub-equipment have been well worth the learning.

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Special coating and 24-hour-a-day production is enabling us to meet the aircraft industry's ever increasing demands for Dural and Manganese Bronze hose fittings.

We are now manufacturing the AN-840 to 849 series. All parts, except bar stock fittings, are pressure tested

by air, under pressure, to 100 lbs. gross pressure. Blueprint tolerances are maintained.

Our production control follows each order from the time it is received until delivery is made to your plant. Write or wire our Los Angeles office, or the branch office nearest you.

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★ Six ways to Boost Production with no Increase in Manpower

... as shown by
Glenn L. Martin Records

Encourage Workers' Suggestions

Martin gives out awards when Merit Award goes, encouraging in the company's Order of the Purple Martin, and a share in proceeds of profitable suggestions for improvement to speed up production. Many short-cuts, new methods add up to big increases in Martin output. Here Joe Tichauer, Martin worker, studies check received for devising a tool that saves 90% of the time previously devoted to one operation.



Get Your Workers Busy Whether alone or in groups, workers are busy. They get more production, more production. Martin employs safety engineers, engineering workers' safety committees, safety committees, and insurance policies. In spite of many new workers, Martin's output is well below national figures, steadily increasing. Here a Martin worker develops a "gun mask," protection against toxic fumes from self-sealing fuel tanks.

Encourage Life-Savings Poor transportation facilities may mean workers to quit or be punctually late. Moreover, there is less chance of thousands of other workers call for the potential theories. Martin set a national record of 15 percent for each car. Martin traffic control and



Go After Subcontractors Don't wait for subcontractors to come to you. Martin keeps 40 men of its Procurement Dept. on the road, using up subcontracting, helping them convert. Result: More that made bottle-nose and wingtips... savings because parachute straps... necks were become exhaust stacks. Today, 30% of all Martin work subcontracted, more fighting planes like those shown above, are being produced.



parking facilities have ended production accidents, and vehicle accidents by 90%.

Watch That Material Potters, organized as unions, good families, modern working methods, long-term, even attacks, of auto Martin needs. But 11th District court, too. Experimentally, Martin found that red work benches made workers short-tempered, blue inked shopmen, given names. A central tin aged production. Alternative shops, called Martin's, and Martin made Speed workers help others personal problems. Also Martin has been reduced for below national average by special workers and facilities set up toward employees. Baker, Emily Day, with Martin function groups of company.



Stay in the Shop Optimized ramp deliveries in Martin plants help prevent work stoppages through lack of raw materials. Enough material is delivered from building of 9 Martin bombers to build a third. Many imperfect parts, instead of being changed and later needed, are adjusted—fewer jobs. Martin (retrained workers) must make to meet thousands of dropped orders, even entire machines of hand making. Also, Martin ramp going back to the side for the repair.

Martin findings on any of the above production aids available upon request by photo engaged in war work. Write: THE L. E. MARTIN COMPANY, SAINT LOUIS, MO. 9, U. S. A.

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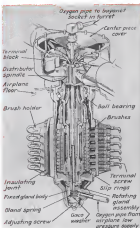


Fig. 10

(Continued from page 231)

ring is connected with the cylinder block. After the piston has no stroke, an delivery takes place. When the cylinder is displaced from center, the slide is displaced from the symmetric position with relation to the cylinder block. Stroke is supported to the piston, which cause several damage, both the cylinder block revolute and outward during the other half of the revolution, producing current while this act in connection with our part and delivery when they consequently with the slide.

An oil supply is carried in a pump in the chamber for making up material bearings are needed through motion return in each cycle. Overload protection is given by blow-off valves in each line, these valves being set at pressure of approximately 1,000 psi. The pressure, which runs at 1,200 psi, is driven by a constant speed 24-v. electric motor running at 4,000 r.p.m., coupled with epicyclic gear to the generator to form a single unit.

It should be noted that the two pumps are controlled independently and both manually and electrically through the

place individually or simultaneously.

Design of the hydraulic system must permit small electric resistance between the upper cylinder 30-v. leading—was entirely cut out when the turret is in operation—in the hydraulic generator and motor. These features used when functioning at the low temperature, at high altitude.

The hydraulic motor, as shown in Fig. 4, is of the seven cylinder, diagonal row type, 2 in. bore and of 0.45 stroke, with the cylinder block as the driven member rotating on a stationary distributor spindle. Power output motor is approximately 100 hp., and the motor is reversed by reversing the supply of hydraulic fluid from the generator, determined by the position of the control handle. Construction materials are stainless in those of the generator, with delivery and exhaust ports formed in the distributor spindle. Protection is made for adjustment of port timing by partial rotation of this spindle. The motor operates at about 300 r.p.m., and maximum is made to the extremely low speed driving gun through epicyclic gearing.

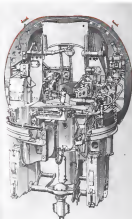


Fig. 11

Gun and anti-race follow normal practice, the only point for constant being in the construction of the piston. All loose joints for retaining the radiator rubber cup members are eliminated and the members are retained by "dead" spring and "P" washers, avoiding any tendency to spinning out or damage to the cup members.

The pressure regulator or metering valve introduced in the pipe run to gun runs serves to maintain a small back pressure on the return line. This unit also provides a means for short-circuiting the gun run when it is necessary to operate the gun manually.

Each gun is electrically fired by a separate solenoid. A single firing button controls all guns and is mounted in the top of the control console. A safety interlocking switch is located in the turret.

One of the first problems to be solved was protecting the surrounding aircraft structure such as tail and propeller from possible fire from the turret. Any excessive effort on the part of the gun was had to be avoided, as it was realized that with gun speed feeds widely

apart and set in the line of sight, the gunner would be looking past parts of the plane in which his gun might actually be passing. To overcome this difficulty, an electrical fire indicator is fitted in the firing circuit, a device which interrupts firing of left- or right-hand guns independently to cover a minimum field of fire.

The arrangement, as illustrated in Fig. 6, consists of a brass drum rotated at the same speed as the turret. Two spring-loaded sliding brushes are in contact, one above the other, on a frame and are held in contact with the drum. They are arranged to slide up and down

the drum surface with gun elevation and depression. Firing circuits for the left- and right-hand pairs of guns are fed by the upper and lower sliding brushes, respectively, with a third brush in permanent contact with the brass drum forming the other connection for the circuit.

On the upper half of the drum, shadow patterns corresponding to the obstructed areas of the left pair of guns are cut out and filled in black with molded modeling material. In passing over these areas the upper brush is in contact, and firing of left hand guns is interrupted. The right hand interrupter

operates in the same manner on the lower half of the drum.

These shadow patterns are usually developed from a turret mounted in a plane, and allowances are made for aircraft deflections and gun characteristics. Principal advantage of this method of protection is that the aircraft shape, no matter how complicated, can be adequately protected with a minimum loss of field of fire.

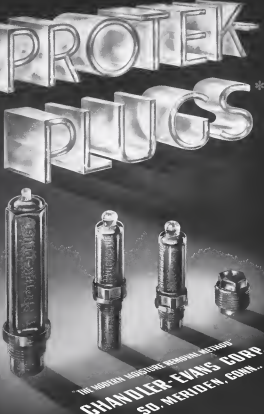
Automatic systems generally follow normal practice, as shown in Fig. 6, but that for tail turret deserves special mention. To minimize weight as the tail, the ammunition is carried in the fuselage and fed to the turret, in steel runways or tracks, through the turret base center and up to the guns, as shown in Fig. 7. This system permits a greatly increased ammunition capacity, a factor of ever increasing importance as present day aircraft needs.

A disadvantage of the remote storage, however, is the stability of the guns to feed under its own power, calling for a power-driven feed motor, as illustrated in Fig. 8, in which the ammunition belt runs over sprockets on a hinged arm, driven from the turret electric motor. Normally the belt sprockets are free, but when the device is in the ammunition belt—between its feed sprocket and the gun—engages a pondermated lever, the longest arm is actuated by the belt pull. This applies a hand brake to an epicyclic gear unit in the drive between the main motor and the belt sprocket and provides a power drive to the sprocket which tends to control the gun.

When sufficient overhauling has taken place to reduce the tension in the ammunition belt the hinged arm returns to its normal position and disengages the power drive. Although the description indicates a definite sequence of operations, in practice the feed mechanism is always working, the belt tension and feed mechanism adjusting themselves to gun requirements. Safety devices in the form of quickly replaceable shear couplings are fitted to prevent damage to ammunition belt or feed motor mechanism.

The Rollins Feed turret mounting may be of simplified design, consisting of two fully modified conventional roller supports assembled to form a double row cup and ball bearing. The lower row of balls takes care of down loads, due to turret weight, and the upper row deals with radial loads, the main driving gear being split, gears ring failure, for assembly purposes. From Fig. 9 it can be seen that the bottom row conforms to normal ball bearing position, the balls running in a reduced groove in the feed ring.

The upper row, however, is formed



The "General" Automatic Rivet Feeder is a simple, dependable conveyor which changes any C&H type riveter almost instantly from an efficient riveter, capable of perfecting machine to a high speed automatic riveter. The Model 3500 Feeder handles both flat-head and countersunk rivets, and can be changed from one rivet size to another in a few seconds.

The operation of the Model 3500 is fast and smooth, and because each rivet is held by the rivet-holding fingers until inserted in the hole, no rivets are lost on the line. The rivet feed mechanism is simple and rugged and may be used with standard drill equipment.

The rivet shank serves as work aligning pilot. This speeds the operation by allowing the operator to check alignment quickly and make sure the hole is not too tight before depressing the operating pedal. In addition there is no danger of work spoiling by perforating the sheet accidentally. In case operator stops on pedal he maintains upper speed will keep rivet out of holding fingers instead of forcing it through sheet. Substantial increases in production develop when the "General" Automatic Rivet Feeder is used.

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GENERAL Engineering Company
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differently, there being a small inter-ference fit between the casing and water valves and the body. The center piece is turned with a smooth finish, the water meter has fine feed hole marks left, and when assembled and runs the ball rolls a smooth race the ridges formed by the machining tool. The product is assembled in a neat assembly from of objectionable dimensional clearance.

Some surplus may be expressed at mounting steel balls on a magnesian alloy track, but tests have shown that, provided a suitable value for each ball bearing is selected, excellent results are obtained since there is no pick up of the ball track, which actually improves with use due to work hardening of the material. Similarly, the gas 2 x 4 bearings, which when the mechanism passes to the gas, one of the full ring needs rather type running direct on the magnesian alloy.

A representative distribution, (shown in Fig. 10) indicates general construction.

Men and Machines Available for War Work

(Continued from page 262)

maximum draw approximately 4-in. deep and black diameter 8 in. hand feed production for 10,000 to 20,000 unit requirements, available for all types of quantity production. Drawn and shaped parts expansion handles parts up to 0.015 in. axial thickness by 1/16-in. black diameter, producing wide variety of alternate sizes required in industrial volume. For such machines for formed parts range in size to handle work from 4-800 to 1/16-in. dia. or strip stock from 0.005 to 1/16-in. thick up to 2-in. wide. Automatic production of blank formed parts required in industrial quantity. Feed and power means handle variety of articles from 0.005 to 1/16-in. thick and up to 1/16-in. maximum thickness and are adapted for large or small quantities. Automatic blanking materials from 0.005 to 1/16-in. thick up to 1/16-in. wide for high speed, low cost production of automatic, large volume stampings. Special die materials and construction, together with special cutting and lubricating methods, have been developed by company for handling various metals and are available for new and broader develop-

ments. Special supply and expeditious delivery is assured.

The first electro-hydraulic turret to go into quantity production was the four-gun 30-in. model designed especially for, and in conjunction with, the Douglas P-40 airplane. The company has, however, produced a wide range of turrets for use, all upper and lower positions of both two- and four-gun models. Fig. 11 shows a cut-away drawing of a two 30-in. gun turret as installed on the Lockheed Stinson.

Among the British and American craft fitted with Douglas P-40 turret are the following: Douglas P-40 fighter, 4 x 30-in. mid-upper, Hawkeye P-40 fighter, 4 x 30-in. mid-upper, bomber, 4 x 30-in. nose and mid-upper, and 4 x 30-in. tail; Lockheed Stinson, 2 x 30-in. mid-upper, Lockheed Venture, 4 x 30-in. mid-upper; and Consolidated B-24 Liberator, 4 x 30-in. mid-upper and tail.

needs in war production work.

Small Precision Parts.....S-150

Northwestern New Jersey manufacturer, with background of experience in production of small precision parts and handling of precision assemblies to AS specifications, offers additional work for various contractors of assembly of all types. Company has recently doubled its floor space, acquired additional machine tools, and is now ready to produce, with adequate skilled labor, the following items: Metric valves, right angle drives for lathe controls, dial pumps, and shifter controls, automatic mechanisms for lathe controls, fuel pumps, and shifter, tachometer adaptors, gas synchronizer drives, flexible shaft assemblies, in-line engines, and precision valves. Also all types. Company repairs complete machine facilities, including all types of graders for precision work and assembly in close tolerances, including Class Four standards. Due to recent additions of tools and floor space, company is prepared to add a third shift to the two daily shifts now working.

Controlled Maintenance

(Continued from page 262)

active centers are to be taken. A record of these facts is maintained and the information is then given to the CAA not later than two days after date of trouble reported. Copies also go to the Wyoming State.

In the coordinating center at Cheyenne,

a new routing-control system has been set up where function is to plan flight distribution in relation to time run on such planes and the probable amount of work to be done, so that no one over- or under-worked. It is intended with long checks to be made while another has less

than an hour. To achieve efficient use of equipment within prescribed safety limits, this department also plans a flight itinerary to obtain all possible safe flights before it is sent to Wyoming for checkout.

When equipped airplanes are taken work from two sets of electric, one showing the sequence of trips to which any one plane is to be flown, the other showing every plane by number being used on each flight for each day. On the latter indicated the check time for every plane at the last major station from which it departed, along with estimates of its stop time ahead, which are changed to exact times as the plane progresses.

By use of these two charts, the equipment utilization engineer can tell, for example, which ship is scheduled to go out on Trip 3 from New York and the sequence of trips on which it is expected to be used. From the daily work chart he can tell whether this particular plane is due for a service check, or over limit which would preclude the possibility of using it on the necessary trips for which it is scheduled. If such is the case, he can set up a reserve plane to take its place until it can be returned in schedule.

Listed as currently flying a total of about 220 in. and 50,000 in. daily, with as many as 22 flights in progress simultaneously at the peak of the day. Since 20 planes are available for schedule each day (allowing for those under repair) this program calls for careful planning.

The No. 1 service check, which is carried at every stop, requires no particular allowance. Flights due have to be made in the order No. 1 and 2, the first before completion of 50 hr., requiring about three hours, the second before 120 hr., requiring about six hours. The 720-hr. overhaul takes at least 96 hrs., and the major overhaul at least 192 days. However, the interval to be allowed for in routing, with something to spare to make sure the ship reaches its base before using up the last hour of its time.

The system allows a station to plan ahead for work coming along and also permits the engineer to reserve a scheduled flow of work through the central maintenance base. The base operators can tell when a certain ship is going to arrive for a 720-hr. overhaul, and can have all engines, propellers, instruments, and instruments on hand ready for immediate installation as soon as the plane arrives. By this means a B-24 bomber is given the 720-hr. overhaul and is sent down and ready to return in schedule just 48 hr. after reaching the base.

Even in the control center, the Wyoming men have attempted to keep constant tabs on all planes and to request those approaching the 720-hr. mark two or three days before they were due there,

which involved considerable wiring without much planning. In these days, the base would not be aware of the exact operating schedule of the plane it was repairing, and the company officials would not know just how much work the base had on hand.

Line service checks were handled, under the former system, by crew chiefs. Advised by a dispatcher of the time on a plane after departure from the last major station, the crew chief would decide whether a check was required at that station. If so, he would be the one to set up any other equipment. This did not

make for last use of aircraft equipment.

Frequently, check No. 2 would be given at the end of 50 hr. of flying, or No. 3 at the end of 96 hr., because of quick turn-around ahead and the possibility that the plane would not get to a major station before its time was up.

Controlled routing is an essential factor in obtaining well timed and well distributed maintenance work, and it has expedited greatly in the present high altitude of airline fleets. In 1941, United averaged one scheduled day for every 86 departures and 20,000 in. of flying. But today the average is one

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Philadelphia, Pa. See Motors, Inc.



TYPE A-70

Height when down 50 in.
Height when fully raised 115 in.
Approximate weight 1000 lbs.
Motor and battery capacity 35,000 lbs.

GLOBE

HYDRAULIC AIRPLANE HOISTS

Flight Testing is a Sound Business

(Continued from page 248)

new members at frequent intervals to check on physical condition

During several high altitude flight trainings, a two man crew is used on each Flying Fortress. In the cockpit are pilot and copilot, the former being responsible for the safety of the crew and the airplane and of maneuvering the airplane in accordance with the plan of attack. The copilot assists the pilot in his duties and shares the responsibilities. Just aft. of the copilot the flight engineer is strapped. This man is

responsible for the coordination of the activities of the rest of the crew, at various stations throughout the airplane, and for making sure that all information related to the plan of test is gathered. If, for some reason, this cannot be accomplished, due to physical limitations of the airplane or crew, the flight engineer in charge is the man who makes the decision for deviations from the original plan of flight in consultation with the pilots.

Generally the case of Leachardine's.

compartments of the *Flying Fortress* in given order to a point-to-point station where an operator and a recorder are located. The radio compartment of the ship is occupied by a radio operator who maintains communication with the flying radio station, and also by either a fluorescent operator and recorder, or a point-to-point operator and recorder. The aft portion of the aircraft, which normally is occupied by the most gunners and the ball turret, contains a transmitter station on tank airplanes and is occupied by a transmitter operator and recorder. These operators can be removed, as, for example, in automatic data plots provided on special test instrumentation and operation and recording.

Data on flights are obtained both manually and photogrammetrically. At Boeing, it is felt that there is a definite place for manually recorded data. In the instance of the flight engineer in charge there is a complete log of the flight as well as the recording of the pilot's instruments. In the case of other stations, there is the necessity of knowing how any previously installed equipment is functioning at all times.

This is particularly important in high altitude testing because so much of this equipment is designed at normal atmospheric pressure and is certified in the extremely low temperatures and low pressures of the stratosphere. By manually recording the data, it is possible for the recorder to verify the content of any time during the flight of a particular test item is not functioning properly. This pilot may then decide if the unusual operation will affect the results of the test or the airplane.

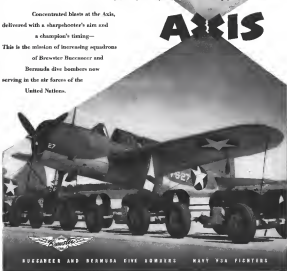
On the other hand, following a flight, the manually recorded data are not immediately available at flight controllers and is usually sufficient for determining the geometry of subsequent test plans of the same equipment. Manually recorded data also preclude the possibility of flight recording equipment completely or partially failing to obtain the required data. It provides a double check on all flight test data, which is of particular importance in a stratospheric test program of large economic interest. The expense of conducting a large stratospheric aircraft such as the B-7 test in the stratosphere is no great; that the additional expense of a complete crew is justified in ensuring that the necessary data will be available.

As outlined in Part I of this series (*Age Attributions*) items to be tested are submitted to the flight test team, where they are given a test number and assigned a priority which determines the importance of the test and aids in sequencing the tests in a test plan. Several such items are grouped together to be tested on a single airplane on a single flight. It is not infrequently the



Concentrated blasts at the Axis,
delivered with a sharpshooter's aim and
a champion's timing—

This is the mission of increasing squadrons
of Brewster Buccaneers and
Bermuda dive bombers now
serving in the air forces of the
United Nations.





IN HIS HANDS...

a crew's destiny

In factories where planes are built, and on airfields where planes are serviced, Williams Tools do work of supreme importance. For they are partners with both the workers and men-in-uniform. Men who hold in their skilled hands the destiny of both plane and crew.

These men rank first among our customers today. Remember, then,



should you find it difficult to secure new Williams Tools, that these you have now will last for years. Used wisely and carefully, they will handle many jobs in addition to those for which they were originally purchased. We will gladly send you helpful booklet entitled "How to Select and Use Wrenches" J. H. Williams & Co., Buffalo, N.Y.

At the desired altitude, level runs would be made at various cruise power settings, during which time all operations and observations would take data and make notes. The power conditions probably would include six or more variations from 2,500 rpm, with maximum torque load pressure down to 1,200 rpm. One

or two more tests are treated as such a single flight. This reduces to an absolute minimum the expense of engine run time. A typical flight might include testing of the following items:

1. A new or different type of propeller which might be designed to give better performance in the stratosphere, or might be equipped with heating or de-icing devices to reduce some such form of attack. In the routine of a first test of such an item, one or two engines would be equipped with such propellers. If the first tests of such items proved satisfactory and further testing was required, all engines would be equipped with them.

2. A new type wing flap designed to provide better response to change in the stratosphere might be another test item. In the routine of the first such test, probably one engine would be so equipped, in subsequent tests, if the desired results were not obtained, additional engines.

3. Another item might be a new type engine used to attain altitude at lower altitudes during its operation in the stratosphere. Here, testing would require engine interference and substitution.

4. A new type bearing in a main propeller might be still another test. On the ground, after the Flying Fortress had been thoroughly warmed up, the pilot would check the best adjustment for the operation of new type main flaps and check the time necessary for them to open and close.

After take-off, the plane would make a rapid power climb to 70,000 to 75,000 ft. During the climb, the various test engines of the crew would record data on the temperatures at the altitudes and efficient burn of the engine equipped with new main flaps and on an engine equipped with the standard equipment, thus giving a check on the efficiency of the operation of the new type at all levels during the flight. The maximum operation would proceed in the presence of normal test runs engine and on a standard engine.

The performance of the engines equipped with two type propellers would be carefully noted, and the turbo-supercharger temperatures would indicate the performance of the system. A jet-engine monitor would indicate the temperatures of the new turbo-booster. Photo recordings would gather other information, including a complete record of standard operating conditions.

At the desired altitude, level runs would be made at various cruise power settings, during which time all operations and observations would take data and make notes. The power conditions probably would include six or more variations from 2,500 rpm, with maximum torque load pressure down to 1,200 rpm. One

or two more tests are treated as such a single flight. This reduces to an absolute minimum the expense of engine run time. A typical flight might include testing of the following items:

An Important Message to Technical Men

The war has earned the manufacturing age to a new peak! Production demands have created technical positions the like of which the world has never seen before. The services of engineers are in great demand. Especially the services of men possessing clear-cut, concrete, significant, proven skill in business dealings—engineers who can "run the show."

In these critical times, the nation needs engineers of executive ability now, today—now, not five, or ten years from now! The shortage of such men is acute—more acute than that of skilled production workers. And companies realize, more of their resources are offering high rewards to engineers who have the necessary training in industrial management.

Golden Opportunity for Engineers

In this new era, the engineer with vision and foresight has a golden opportunity. He will realize that out of today's tremendous production battles will emerge technical men who not only will play a major role in winning the war, but who also will be fully equipped to help our country prosper when peace comes.

However, before the engineer can take over executive responsibilities, he must acquire knowledge of the other districts of business—marketing, accounting, and finance. He has no opportunity of a new union of technical training and experience. But in order to grasp the opportunity, he must first understand the production field—he must also have an understanding of general business principles and methods.

The Alexander Hamilton Institute's intensive executive training can give you this essential business training to supplement your technical skill.

FREE offer for engineers

Ever wish the war began, then, has been an extremely busy period in the history of our country's technical training. The Alexander Hamilton Institute's intensive executive training can give you this essential business training to supplement your technical skill.



15-6000 men on the operating side of business have resulted for this training. More than 37,000 are technical men—engineers, chemists, metallurgists—many of whom are today heads of our large war industries.

The executive training for engineers has been a great success in the thinking and experience of the country's great business minds. It is especially valuable to all men because it has, not only provided a sound, proven, providing a thorough groundwork in the fundamentals underlying all business. It covers the principles that every technical man should understand. It applies to all types of industrial organizations, because all types of production are based on these same fundamentals.

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The Institute's training plan has the endorsement of leading industrialists and business men. And it is only because these high-ranking executives recognize its value and give their cooperation that such a plan is possible. Among those who contribute to the General are such men as Frederick W. Philbrick, Vice President and Director, E. I. duPont de Nemours & Co.; Thomas J. Watson, President, International Business Machines Corp.; James D. Mooney, President, General Motors Overseas Corp.; Clinton Johnson, Vice President, General Tire and Rubber Co.; and Ralph M. Chester, Chairman of the Board, General Foods Corp.

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Do you have ball to substitute into production service, for repair, on electric lights and apparatus, and such work which can be done with ball? If so, you will find it in the Baldor grinder. It is a machine which can be used for grinding ball, and it is a machine which can be used for grinding ball, and it is a machine which can be used for grinding ball.

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AMERICAN PHOTOCOPY EQUIPMENT COMPANY
3101 N. Oak Street, Dept. 100, Chicago, Ill.

Airline Gains Invisibles

(Continued from page 212)

usual advertising program devoted at the show.

The last factor trend recorded by the show is particularly interesting in that 1935 the first year recorded, showed a 40 percent, rising the 57.64 in 1936, if on shopping back to 48.18 in 1937, when it began to show slowly through 56.15 in 1938 to 56.16 in 1939 and 57.60 percent in 1940.

Although the number of revenue passengers flown decreased 11.5 percent from the 1941 total, revenue passengers grown 21 percent. Further clear evidence of more efficient use of aircraft is shown in the fact that, with less than half the planes available, revenue miles flown increased only 17.2 percent. Part of the decline in number of revenue passengers, there can be attributed to the frequent reversals for blocking off passenger seats to make space available for high priority cargo shipments.

Passenger miles per passenger fatality during 1942 dropped from 63,404,963 to

54,814,048. This was lower than 1940's 22,784,141, and far below the all time high record of 85,306,670 miles per passenger death set in 1936. But though passenger fatalities increased by 20 to a total of 55, the CAA pointed out that "during 1942 the safety record of the airlines was considerably good." Adding that "the safety record is noteworthy when it is remembered that war-time reduction during the year was over the situation point. With all seats occupied, any moment a crash could mean a plane load of fatalities. Yet one new from the record that in 1942 the number of fatalities for which civil operations could be assigned responsibility increased only 21 over 1941. A useless army pilot noted 9 of the 1942 passenger fatalities in civil airlines occurred.

"Airline efficiency is evidenced by the fact that the three fatal accidents for which the airlines are responsible are outweighed by some 6,000,000 unoccupied seats and loadings."

Points on Plastics in Aircraft Engineering

(Continued from page 180)

7 The close dimensional accuracy, permitting no warping of the part is recommended.

8 Thermal expansion in service will affect dimensions.

Wall Thickness

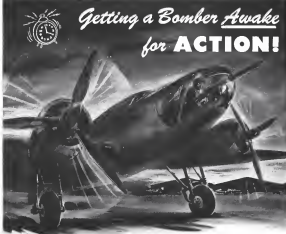
Proper thickness of wall is, of course, governed by requirements of mechanical strength as proper dielectric strength in insulation values. It is well to keep in mind the following general factors:

For the maximum thickness possible consistent with a satisfactory part, the designer should use the factor the more slender the better the use of material. However, avoid too thin walls that are fragile, as such applied maximum will lead to rejects and failures in service.

Wall thickness for average small parts is generally about 1/16 in. For larger parts, such as radio cabinets or instrument cases, 1/16 in. wall, occasionally with reinforced by ribs.

Thin plastics may be used with maximum wall thickness of 0.005 in. and maximum thickness of 0.125 in., with the average being 0.030 in. As the thickness of section increases, the tensile strength and dielectric strength decrease.

Walls of uniform thickness will reduce the possibility of stress cracks and resultant stresses. If both thick and thin sections are necessary, it is good practice to ease the thicker section to promote uniform stress. In the best design, thickness of section does not re-



... and getting it awake under every conceivable condition—on base field or emergency field, in sub zero or tropical temperatures—that's the job entrusted to the Andover Auxiliary Meter.

In addition to main engine starting, these compact, light weight powerhouses also furnish a dependable flow of electric current for other vital bomber equipment—boost boost, interphone communication, radio, lighting, heating, instruments, turret operation, galley hot plates and ventilation.

Not the least of its features is the fact that in conventional design conforms with accepted aircraft practice. Andover Meters are playing an important part in today's fight—and for tomorrow's great future.



The Andover Auxiliary Meter is a 3-cylinder air-cooled engine driving a 24-watt generator supplying a continuous power output of 18.6 kw. with a peak load of 70.6 kw. Its output can be used for a wide variety of purposes, including generator and regulator box, is only 125 pounds.

ANDOVER MOTORS CORPORATION • ELMIRA, N. Y.
WHOLLY OWNED SUBSIDIARY OF ANDOVER RENT AVIATION CORPORATION

Simplifying "AWKWARD" DRILLING JOBS

These difficult, cramped working areas in aircraft production are easily and efficiently handled with Terry's unique drilling attachment. Features are listed to show how the machine delivers Terry's advantages and built-in details are arranged.

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258 North Cleveland Ave.

Buffalo, N. Y.

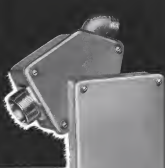
ANGLE DRILLING



ATTACHMENT



THE MYSTERY OF THE MATCHING COVERS!



PRECIOUS hours have been saved on the production line here at home and in service depots at the frontlines, by Unosair's care in turning out precision housings and covers to a degree of uniformity that makes one and all absolutely interchangeable. The solution rests in the fact that Unosair drill jigs, with which holes are drilled and tapped in both housings and covers, are continuously checked by its own engineers and completely equipped tool room, to prevent the slightest variation in position of screw

holes. This is characteristic of the engineering skill with which Unosair produces its masterpieces.

Makers of
UNIONAIR JUNCTION BOXES
and **ALUMINUM CONDUIT FITTINGS**
UNION AIRCRAFT PRODUCTS CORP., NEW YORK

cover at it approaches the finish line. Decreased surface of ribs will help in the molding operation since the material becomes drier and more tightly confined as the metal penetrates. As the material flows up the side wall, the decreased thickness gives a wedging action which assists molding pressure. Proper side wall taper aids in easy release of the part after molding.

Notes

As to molding design, fillets are always in order, flow, particularly of the thermosetting materials. Then overcome structural weaknesses caused by stress concentration in sharp corners. Decrease use of fillets will also serve to simplify the mold construction and will consequently reduce mold cost. As a further corollary, they strengthen the mold. Usual fillet radius is $\frac{1}{8}$ in.

Before covering fillets are more or less similar to regular engineering practice as exemplified in metal, wood, or die casting. They are relatively easy to produce in the mold with milling cutters.

Where materials are sluggish in flow, or where deep moldings are involved, the use of pressure fillets in highly recommended. There is one exception to these recommendations. Fillets should not be used at the parting face of the molded part. These corners should be squared off so that finishing is simplified and so that the fillet can be removed readily by grinding or sanding.

Inserts take into account such factors as: (1) required mechanical strength of insert in the plastic part, (2) release in position of insert, (3) tolerance on threads in insert, (4) tolerance on length of projecting portion of insert, (5) required electrical characteristics of insert in the plastic part, (6) molding material to be used, (7) method of molding to be used, (8) position of insert in plastic part, with reference to manner of molding, (9) position of insert in plastic part with relation to flow of material in molding, (10) amount of molded plastic around insert, (11) general size and shape of working part, (12) material of the insert in metal, (13) material of the insert in plastic, (14) operations to be performed on insert after molding, (15) effect of insert on scrap loss during molding or finishing.

Bed inserts must be used with comparatively soft or free-flowing molding materials. Their use is restricted to injection molded or transfer molded articles in any favorable design to maximum molded articles. Very little side flow of material under pressure can be permitted, for the inserts will load readily or even shear off. There is no general rule about length of insert imbedded in the plastic mass; this will depend upon the pull which the

inserts need stand, the molding material used, the insert material used, and the flow of material against the insert. In determining inserts, the designer should be quite shallow and preferably in the hand-drawn section. Imbedded shoulders will provide anchoring against axial displacement.

Where the projecting length of insert is important, or where the surface must be kept free from scoring or finish, a displaced insert should be used. This should be classified (as should all inserts) and may be different if desired.

Inserts with female threads should preferably extend above the molding surface. This is desirable, of course, as it helps support the insert in position at the same time that it prevents material flowing into the threads.

While many pointed, stamped, or formed inserts are used, there is usually difficulty in holding them in proper position in the mold. Flat head or oval-head screws can often be satisfactorily used. But round-head screws are not very satisfactory, since pressure on the head shortens the length of the thread and molded material gets in the threads, necessitating a cleaning operation. Avoid square or sharp corner inserts, for material will crack on shrinking. For open-end inserts, cycles on some inserts be used, although most or some one-line inserts are to be preferred.

Threads

Threads may be molded in the part—as an area parallel to the mold cavity. Molded threads may be increased from the end directly, or opposite thread plugs may be used. With plugs, the complete molding is removed and the plug removed while the molding produces continuance on the next piece.

On parts of unusual design where it is impossible to remove a solid piece from the mold, the parting can be made along the thread centerline and a spring die run over the thread to remove it.

Threads should be started at least $\frac{1}{2}$ in from the end of the face perpendicular to the axis of the thread. This will result in a stronger molding and will eliminate the possibility of a finish edge on the molded part. No more than six threads per inch should be specified. In small diameter holes ($\frac{1}{8}$ in and less) which are to be tapped, the designer should provide a slight cone, taper at the molded part. This will prevent core entrance and withdrawal of the tap and prevent cracking at the edges of the tapped hole.

Parting

Various fastening methods (see Fig 2) are available to the engineer using plastic in his designs. Inserts, tapered holes and standard screws, conical bolts,

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The more difficult and time wasting your operations are now, the more these little ingenious devices, used on your own portable or flexible shaft tools, will stretch you with the ease and speed with which they slip through them.

They are absolutely revolutionary in the way they remove burrs and soil marks along edges and from concave areas; polish channels and fillets and rim corners, clean up sidewalks and bottoms of dead-end holes. Their resiliency assures a beautiful finish following up Mounted Points and Wheels. These are mere hints at their versatility.

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By the way, here you see for the first time our booklet, "How Fast for Faster, Better Production?" It shows all the "gadgets" in use and lists their prices. Copies for all your departments will be sent upon request.

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Write to ROBURN AGENCIES, INC.
114 Warren St. New York City

Fighters, Bombers Fly Home For Repair

(Continued from page 125)

R-17's, B-24's, C-54's, and C-58's.

From the same section come section drawings which showed with varying frequency. It is a basic structure in which a desirable, yet, stipulates the losses to the point where a special lay-out must be created. A heavy boiler plate must protect the water against injury in case of breaking through the 400-lb. pull assembly to pull the hinges to their full length.

All along the production line are stock bins containing small supplies of parts for work of the various gangs work on their own, a crating plant has paid its way many times over its time saved.

Early in the progress along the line, the 400-lb. and loss in engine, and propeller, which are taken to their own section for repair. The propeller unit receives not only all the propeller on planes flown to the depot, but it gets many in very noticeable condition—from air depots and air bases all over the country, each control target, such as OCAIL, serving its purpose as a wing. Using simple, standard equipment, the (Turn to page 127)

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landing conditions. These markers stand out clearly and are visible and easily read from great distances when directional errors or legends are on them. Landing lights from a plane played upon the markers are the only necessary lights required. These markers also and where blinding field lights remain on.

'SCOTCHLITE' markers are also used to mark runways for use when landing with or without field

lights. When used with landing lights on the plane, the pilot is the only one who can see the clear reflective markings which are distinct and visible throughout the descending glide in 'SCOTCHLITE' markers have sufficient reflective area to be visible at great distances.

'SCOTCHLITE' comes in roll form and can be easily applied to markers without the aid of extra tools or heating equipment. For your convenience in making a fast test, we have markers already made up at reasonable cost.

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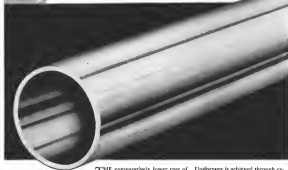
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Uniformity is achieved through coining, constant in production process and by thorough inspection at every step in manufacture.

Where lower cost is a factor and high-grade stainless steel tubes are required, GLOWELD offers an economical and satisfactory solution to the problem . . . perhaps to a problem of yours.



Microphotograph of weld area, showing grain structure of weld and parent metal.



GLOBE STEEL TUBES CO., Milwaukee, Wisconsin, U. S. A.

craft line everything from small boat training plane propellers up to the fully expensive turbopropellers. Various types. The best is that "they" never yet had to believe for a prop to get a ship back in action." The propeller section has only one separate department, that for blade strengthening. Otherwise, one crew follows through from test down through repair, polishing, manufacturing, and balancing.

The engine section represents perhaps the highest degree of mass production technique, since it must turn out one, two, or four engines per plane—mostly the latter—and they range from 40-hp. tractor power plants to liquid cooled in line 8-cylinder and radial smoothed booster types. The engine section's March quota, for example, was 260 engines. The 672 was the figure actually reached.

Often the engines get to the section in quite a hurry. Recently for instance, a fuselage was removed one from a B-17 in 30 min. Types delivered, for example, the engines are mounted on movable dollies and started down one of the two two-down lanes (a third one will soon be in operation) where separate crews perform certain groups of time-consuming operations. As the parts come off they are placed in adjacent bins which are moved to another group of workers who key-number them all. Since larger parts will thus have their own serial number tags, similar ones on barrels minimize correspondence mistakes, so that each engine is maintained to a large extent, as the same unit throughout.

All parts that move to the drawing department, where some get clean and soap bathed, others get hand cleaning in different types of solvents before starting through the repair and inspection departments. Then, on a tight schedule, they move toward the two final assembly lines, where different groups of skilled mechanics, spread in assembly line stations, quickly make complete engines of repaired and new parts.

These assembly lines end over a dock, through which the engines go immediately to the test building containing twelve cells which are in operation every hour of the day, every day of the week. Perhaps the best indication of the engine section's efficiency has been found here, where many overhauled engines show a lower oil consumption than they had upon leaving their respective factories.

To keep pace with today's global war exigencies, the test building has what is claimed to be the nation's largest gas-made weather and yet put in operation. Any or all the test cells can be changed from 500 deg. F. to 90 deg. below in just 4 min., with any degree of humidity desired. Thus, when GLOBE or any other depot, made a plane to Africa, it



FOR THE NIGHT

"The night has a thousand eyes" . . . and they might all be International Flares and Signals lighting up the skies to guide our fleets and soldiers to safety . . . bringing closure the day when they can enjoy the glow of Victory.

The name "INTERNATIONAL" on Flares and Signals for Aviation and Marine use is a hallmark of quality . . . the same quality and dependability that our fighting forces and those of our allies stake their lives on.

Expanded facilities still permit us to serve commercial customers whose priority ratings are applicable.



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DARNELL MANUAL**

Alaska, or to the South Pacific, or to Korea (the engines will function no matter what the weather).

When the A-1E's, K-1's and last ones in the line, were ordered for the first time, the One group, for instance, divided it all of the available air engine and flight instruments as essential to machine flight and long range precision bombing in the quest of a modern, air conditioned ship, each member of the instrument service takes each job all the way through from disassembly to final check, top of the instrument assembly has 100% experience in this service—lengthy use and power from varied maintenance—has qualified on at least one group of instruments, but to maintain the very ability necessary to meet with changing schedules, many are equipped to repair any instrument in any place.

The same process was employed by the instrument service, which is one of the largest organizations of its kind in the country. Despite the fact that parts are regularly taken out of place, repaired, tested, and re-installed in 8 hr., there is no trace of sloped work. This is due both to rigid inspection and to the fact that many employees—a large number of them women—have seen, located, or even found the place that go through OCAD. Here, again, is a good example of the service as evident in the Air Service Command's bomb release check, each with which the vital parts are tested before re-installation in the plane. Connected to the instrument service, it was built with the cooperation of Indian officers and men. The next night? Many accurate work at a saving of 55 percent in time.

When modern crews bring their planes to the Oklahoma City Air Depot, they may even leave the parachute, for this is a section which not only repairs and inspects, but also checks and ships new ones to the depot's battle-front in the field. In fact, the crew can simply walk away from the plane without even removing their "put up girls." For a special group will take care of every atmospheric gun such as the next engine, life raft, and oxygen bottles. These are all serviced, checked, and stored until the aircraft goes through the post-flight, reasonably, and out the door the delivery to the flight and test section.

This section has a record service crew for A-1E installations—and a single entry to date, although an test plane may be used upon to fly any or all the 56 odd types of aircraft now in service with the AAF. That, of course, is in addition to handling all transport flights, which have gone well over the 1,000 per month mark. When the test flight crew finishes, the plane goes to the ferry, for final check of all parts and is then sent to the "post patch," a thoroughly insulated room, to get its quota of am-



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ADVERTISING, June, 1942

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War Production demands maximum speed and absolute precision. Both of these requirements are met in hundreds of war plants with South Bend Lathes.

Their rigidity and wide range of spindle speeds permit taking full advantage of the higher cutting speeds possible with tungsten-carbide tools. Their dependable accuracy makes it possible to machine work with such precision that subsequent finishing operations can often be omitted.

South Bend Engine Lathes and Toolroom Lathes are made in five sizes, 9" to 16" swings. Write for a catalog and the name of our nearest distributor.



Use THESE BOOKS AND FILMS ON LATHE OPERATION

South Bend training helps—books, sound films, wall charts, and lectures on the care and operation of a lathe—are available for training new operators. Write for Bulletin No. 22-C.

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operation and saved six market ones. At this point it is practically a new plant, ready for instantaneous action—and it is but a few hours' instead of weeks or months' from needed status.

Being plans ready for this occasion, with the utmost speed in three Indianapolis City Air Depot's main job, and then is typical of the other two control depots. But this by no means covers all the activities. As a supply depot, OACD is really big business, as indicated by its stock of more than 150,000 separate items now used by the Air Force. Each of these parts has its own bin, its own number to expedite delivery. The depot could build complete airplanes. It also could equip the men to fly them, for its training department does everything from desert map glasses to electronically heated flying suits. Its size can be judged from the fact that the large main building is one of 31 structures on the reservation. So vast are depots that a messenger often has been set up simply for slipping of outgoing shipments—most of which are in containers made by the shipping section's own hot factory—which may range from a roll of safety wire to complete airplane wings.

These shipments go by rail, by rail, or truck—any way to "get the stuff where it's needed." Today there are daily scheduled air freight flights of the Air Transport Command. Within a few months, however, a new air freight terminal now under construction will be able to handle a flight every quarter hour. Already, however, ATC has flown more thousands of tons of "hot freight" per month from the OACD to fighter and bomber bases throughout the world.

Doing more than its share of saving material at the lowest possible cost is the major job which, with but some freights that have occasionally moved but, for close to million pounds a month, appears to be one of the heaviest and fastest growing tasks now in the country. Recently acquired equipment is cutting the total cost higher although its costs are not being extended. They can't be. The major goal has delivered, under needed supplies to both units. With two drivers keeping the trucks rolling at least 100 hr. a day, no point in the United States is more than 48 hr. away from the depot. The major point, where load point is unusual, careful planning has kept it up to almost 100 percent.

Then there is the maintenance section, doing an outstanding job of saving the taxpayer's money. Suppose, for example, a training plane is "crashed out" or a training late in one of the states covered by the depot. The damaged craft is tracked in for survey and, if it's more than 75 percent repairable, it is ordered dismantled. Every suitable air



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METEX AERO COMPOUNDS—Designed for precision cleaning of aluminum and aluminum alloys. Gives maximum speed consistent with all other desirable properties.



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METEX ALUMINUM CLEANER No. 8—Especially developed for speedy—positive removal of alloy marking, lints and drawing mud stamping oils from sheet and shaped aluminum.



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responsible part in achieving this thorough cleaning—including Magna-Flow—the parts go into storage and are added to the Depot's supply. An unscheduled visit to the section showed a situation of scrap parts perhaps 100 lb. of machine elements gathered from the scrap shop, a few propeller pins and bearings on their way back to the factory for re-working, and pounds of safety wire which had been removed from engines brought in for overhaul.

One of the most interesting departments of the sub-armory was the highly trained machinists. An efficient line of brooms that ran clear from the machine area, lined with a crash landing due to landing gear or other failure, a motorist, it is possible, is permitted to OCAAD's Tanker Field to make his belly landing. Recently, on a Wednesday morning, this reporter saw a Boeing B-17 which had made a belly landing into the preceding Sunday. All skin treatments had been made, the hull insect eradicated and cancelled, the landing gear system had been repaired, the propellers straightened, and the engines were already by the engine area position. It seemed that a sophisticated heavy bomber got back into service less than a week after a crash landing.

Another noteworthy remittance section is the wood mill, whose members will turn out anything from a section of cockpit housing to bathroom furniture. The last said is made as it sounds, for wood will make all the wooden furniture for "Hill OCAAD," the rooms and dormitories located in one of the hangars to accommodate transient flight crew. In spite of its reasonable rates, Hill OCAAD is going to be big business, as is indicated by a current expansion program.

Just an important as any of the Depot's operating units, is the pilot and training department, in which workers must be educated for OCAAD's growth.

Although all services and departments are headed by Army officers, all air planes are civilian operating under Civil Service. Currently the training division has several thousand students, a number which will be increased, their longer practice program on "upgrade" training leading to higher ratings and supervisory positions. The first work of training is largely one of orientation, leading up to a meeting with the leading and planning board for suitable tools and equipment for those needed shop practice in the line of work for which the applicant has been found best fitted.

By far the greatest number of students are women, whose ages range from 20 to over 50, a clear indication that the depot's present 30 percent feminine employees will soon exceed the 60 percent mark. Here, too, is most-the-clock operation, since the training section tries



They're on the last lap

These racing gun bullets are leaving their way forward a Zip Zero—about to complete a job that started several hundred miles back.

Gas-powered shot them down the home stretch—but gasoline earned them most of the way.

A lightning phase is a machine gun rest on wings—a flying "pillbox" that has to be maneuvered into position. Pilot's skill and engine power do the maneuvering; engine power, in turn, depends largely on the quality of gasoline the engine can be designed to use.

Long before the war, chemists and engineers of America's petroleum industry matched brains for ways to make new and better aviation fuel. War found the industry ready to roll—ready to turn out the vast quantities of "fighting grade"

gasoline necessary for sky supremacy.

Into each gallon of this super-gasoline—and into the military machine for maximum land and sea weapons—goes Ethyl antiknock fuel. Its boost already high-octane ratings still higher; it packs in that extra punch.

Ethyl has gone to war—as every front where gasoline is used. And when at last the war is won, these new and better fuels "with Ethyl" will help America lead the world again in aviation and in automotive transportation.

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Manufacturers of Ethyl fuel, we have it refined to improve the antiknock quality of motor and aviation gasoline.

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Experts advise at least 10-15 cuttings a season (depending upon location and weather) are required for development of the best turf conditions, and this is important because thick, dense turf



Keeps down dust which is a cause of too frequent plane motor tear-downs and parts replacements.



Helps eliminate hazards of loose stone, gravel, etc., injuring propellers during motor rev-ups, take-offs and landings.



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Helps eliminate wheel marks as high as 30,000 feet.

Worthington was the first to study the new problem of turf cutting on the war Airfield acreage and has developed the largest capacity turf cutting apparatus for this purpose.

A machine pulling a 5-gang Mower cutting a swath 31.2 feet at a speed of 15 miles an hour will cut 35 acres per hour—a grass cutting capacity over three times greater than any other make of tractor and gang mower combination now available.

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to keep the airway with increasing demands. The civilian airlines are not the only "airfields" for several thousand enlisted men occupy the vast military area, spending from a few weeks to a few months getting special training for engine and aircraft maintenance both at home and abroad.

Although its growth has been phenomenal, the Hickam City Air Depot is no temporary wartime operation. Though it may shrink away from peak employment, there is every indication it will serve a good sized Air Force for a long time to come. Its Tanker Field, with 4,000 ft of paved runways and swiftly growing air freight terminal, can serve the cargo ships of peace as well as those carrying the "hot" freight of war. Its large repair building is a substantial, steel semi-permanent structure, to serve the bombers. Its supply buildings have been built to last. Its aviation personnel are steady men and women from neighboring areas. Air Service Command is playing a vital role in winning the war and its depots, its permanent aviation organizations, promise to do just as much in keeping the peace.

War Communique No. 18

(continued from page 113)

destruction, and death replace their roles of world domination, comes from that Nam U-boat warfare is harassing British and American air war. Submarines are taking a million tons of our shipping per month with all goods on board, and the Germans are responsible for nearly all of Japanese harbor gets a look-in. If we are doing anywhere near that much "harassing" damage to Germany by air attack, we are doing pretty well.

Two force leaders Goebbels' statement on the truth. The Russians-Joseph Stalin himself and his Red Air newspaper—our new German Allied air damage to Germany without mentioning, presumably they are and benefit by the results of it. Many observers believe that weakness of the Luftwaffe is to a large extent, the result of damage to German airplanes. The other man, Goebbels, it must be added quickly, is the destruction of German planes by Allied planes in combat. No small part of the credit goes to our own bomber and fighter crews who have been mowing down attacking Spitfires.

When even the ground action experts disagree, it is useless for editors to comment on the problems the Allies face when they invade the Continent. It looks like a tough job which might be made easier by a sufficient amount of credit, subterfuge, and subterfuge from within.

But in the air the way should look clear. Our air forces can go where they want to go and do whatever a limited air force is capable of doing. We may launch because through our forces, AAF and RAF combined, will be big this winter and autumn, they will still not least the scores of thousands of bombs and fighters of which the air war is a part. Even such year we shall not have them, for this year, the United States will produce less than 100,000 planes of all types, the English somewhat less. We could never the ships of Europe's planes, as the air people say, only if we stopped making other kinds of war equipment.

Allied destruction from the air in Europe will increase as our equipment increases. But we shall not be able to devastate Germany as effectively as we could have done a year or two ago. The Nazis are learning how to fight back from the ground, they are learning how to take shelter, how to dig out, how to make repairs and go back to work—just as the British did. They are also thinking of themselves as a brave people fighting for a cause—plenty of them at least—and they might go beyond the margin of human endurance, just as the English did. The art of semi-legend and underground instruction in engineering every

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The Herman Nelson Portable Self-Powered Heaters, originally developed for our armed forces, were successfully used last winter at Army and Navy Bases everywhere.

These portable, light-weight, sturdy, self-powered ground heaters are now available to commercial users who are engaged in our production work. Write today for complete information and please include a statement of your particular heating problem.



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day. Some military airplanes in Europe cannot be hidden, but themselves have been bombed or considered so effectively that they can't be found without help. Much help, of course, will be given by agents and by enemies of Hitler.

Unfortunately, if this is not the last war, it may still be the last opportunity for a demonstration of unaided air war against fortresses, the source of all military effort. By next time so many factories and base of communication may be buried or demolished that air forces may attack in vain, only to live up prayers of dust. Even the cities

may be dispersed so that will people there cannot be terrorized. World War III could be a great disappointment to any powers hoping to sweep the world clean with bombs, bullets, and propeller attack.

A good example of what aviation cannot do, at least in this war, is on display in the Aleutian islands where the Japs have landed in force, established habitations, and nearly completed a couple of airfields. From these fields, of course, they hope to organize an Alaskan shipping and naval forces and, perhaps, to attack the coast of America. They couldn't do much to

our Army here from Alaska to Russia, it's too far North. Our air forces have been attacking these meager Jap installations often a dozen times a day, with substantial bomb loads, but the airfields keep on growing, just as the war in the same area.

In the East, where Japan has completed conquests as amazing as some by the Germans, even the Japs did much of it unhelpfully, there is no change. They may not be any important change for some time. The Japs apparently cannot cover the New Guinea or Australia, we are holding them. But they are holding us, too. If we knock down five of their planes in three out of four, they bring up the next to our use. Our submarines apparently have not yet seriously hurt their merchant shipping. We are guessing as they struggle in aerial construction, and that will tell when the day comes.

Manufacture, Chevrolet, and the other manufacturers in the East and in Hawaii are in almost unbearable positions. They want to attack, they have demonstrated that they can take the Japs but they haven't got the full number of shipping planes, and the Allied command isn't letting them have 'em. Even the compelling Madam Chiang Kai-Shek has produced no yet-apparent change in our policy. The weight of our constant messages reveal an iller.

One Manufacturer's conference of both in aviation caused a palpitation in the hearts of Japan and between all over the world. He said the Navy could get nowhere without strong air support. That period Navy has known a little bit, and it probably didn't make a very tender bit with Old Seiler Roosevelt in the White House. Some people on the side lines said it wasn't the way to get more airplanes in the Pacific. But MacArthur's influence is great, and his words, standing in many attacks, may well become upon the Japanese.

All this proves that what is left Japan is a very long way off, except China. But China has unlimited manpower. If the Allies can implement that manpower with supplies and weapons, then will do the Japs in. Chevrolet says the Chinese are just as good as the Americans in any combat. Most people who pretend to know about the Russians say they, too, will jump the Japs as soon as the Germans are liquidated. This is all guesswork. But the Japs built the Pacific off the Russians in that war 40 years ago, and the experts say the Manchurian never forget. Indeed, the latter are reported to have already shown the Japs a flag or two in those narrow border clashes. It would make a whole of a difference if Stalin would merely deliver war on Nippon and let us see his back yard.

Photo Courtesy
Douglas Aircraft Company



Maker of Air History— The Douglas "Skymaster"

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A pair of "Wings for Victory" by Douglas, the new "Skymaster"—Army C-54-Crafts Transport. Combining great size and power, this new Douglas will be an important unit to service with our advancing troops.

Here's another instance in which America's enterprise is maintaining leadership for our armed forces. The performance of the plane depends on the thoroughness of the skilled workers who make it—the quality of the products they use. Here is another place where Belden wire goes to war.

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It's no less big where Belden wire is found in your flying laboratory at the Douglas Plant

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"There aren't any blind spots—
We're using CHERRY RIVETS."

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This mechanical blind rivet has proved itself in thousands of aircraft and due to its high shear and fatigue values is opening new doors for the engineer. He can now design up to efficiency rather than down to a manufacturing limitation by specifying Cherry Blind Rivets.

The complete story on Cherry Rivets is available. Request your copy of the new Handbook A-43 from Department I, Cherry Rivet Company, Los Angeles, California.

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But, to get back home in our own front yard? We still haven't reached production. The Aircraft Production Board still hopes to run the monthly rate up to 14,000 by the year end, but head-bashed automakers don't think we can do it. They think that though we will exceed 80,000 planes this year, we will miss the all-quoted 100,000 mark.

The high-tech gasoline-rubber controversy may soon join the needs-forced fuel jet. It never threatened air training and evolved as much as most people

stained it did. If not, the national spirit of populism, which is still going on at a great rate, would have been stopped. Moreover, the use of parts and materials in rubber plants, and gasoline plants, too, did intensify slightly with aircraft production.

The Independent Air Board has tightened its control on military and civil air traffic, which means that the government now has its eye on every wheel of a propeller, on every drop and nut, which was to be expected.

There is going to be more argument

about aviation taxes and states rights and local money powers than you could shake in the Congressional Lottery. It is just getting started with debate on H.R. 1811, which is a rewrite of the Civil Aeronautics Act, of 1938. Before it made it you know that long, were one of our public-law stories, as perhaps even one of our larger towns, is going to tell the national government of some pompous country overseas that it need fly through our own sky, and I don't, praying from the long-distance application received by the Civil Aeronautics Board from United States airlines that want to fly over God's Heaven, a lot of people from development to Japanese will have an opportunity to tell us the same thing.

Mass Production Overhaul

(Continued from page 210)

to the point now, from which it will proceed to primary assembly.

The propeller is taken to the propeller cone where it is stressed, inspected, tested, balanced, calibrated, adjusted, polished, and protected against corrosion before passing on to final assembly storage from which it will emerge as its "hammer comes up".

The landing gear goes to the hydraulic department where it is completely taken down, cleaned, and inspected. The master cylinder, valves, and hose lines are installed, new hose put on the wheels, new fluids added, and all adjustments made before it proceeds to final assembly.

Propellers are lowered from a plane (or lifted from a parking pass if shipped to the Dept. that way) by hoist and are fastened to a dolly for transport to the engine department, housed in a separate building. These lines are completely dismantled, parts are cleaned, paint is removed, and each is rigidly inspected for wear and flaws. After cleaning, each part is placed in a special location on a four-foot vertical rack, its position there or be returned to that particular position if removed for any reason, as the rack proceeds through the several stations of this department. Each rack contains the parts of one engine.

Magnets, pistons, carburetors, spark plugs, starters, and other cylinder parts, are sent to the assembly repair department where they undergo the same cleaning, assembly, inspection, repair or replacement, and ultimately followed in all other departments. They follow the engine after parts regarding it have been painted and the engine is ready for assembly. Before that begins, however, the rack proceeds to the

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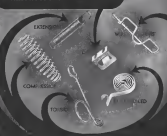
POWER—stroke develops 145 p.s.i. at 1000 p.m. Motor weighs only 40 ounces and compact design of motor enables built-in flange to be used for mounting. No damage to motor, permitting use of flange to eliminate flange in door assembly. MOTOR DRIVE—has external bleed line required, allowing additional flange. ADAPTABLE—has built-in flange or foot mounting for all conditions. (See mounting literature.)

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*The twenty-four new pages have already been mailed to those who received the 1941 Edition.

any necessary machine work is done. Assembly of sections begins in a subassembly department where locations are arranged down the center of a long room, each constituting a station of the line. Two lines of racks, spaced just three feet apart on each side. At each of these benches or stations, specific operations are performed so that in the time an engine rack has passed through all of them the rear section of the case can be fastened to a specially built daily on which the engine will travel through final assembly and on to the test stand.

There are six stations on the engine final assembly line, in each of which a team of two men work. Operations are so laid out that they require but 45 min for completion. When the work is finished, the engine moves out of the building to the test stand building, where it undergoes the required number of hours of tests. (Engine test run is 45 hr at various speeds, ranging 15 to 30 min at each speed.) When assembled in perfect condition, the engine proceeds to final assembly or is "packed" against corrosion and sent to the shipping department for longer for shipment both in the wheel which sent it to the Depot.

All wing structure is directly from disassembly in the same repair department, where tubes and fittings are removed, patch and assemblies are done and suggested damaged hardware—brackets, bolts, and fasteners—and spars and ribs are replaced. In the highly important department next now is returned to us that no wing with parts which are old, warped, or cracked is permitted to go forward without repair or replacement. Even leading edges are measured in place but in make absolutely certain of their perfect alignment.

When drawing, inspection, and stress drawing are completed, wing structure is moved on rollers and racks to the fabric covering department. Final steps are made here in re-covering, attaching from various materials, where all flanges, cables, controls, and other equipment had been installed. Inspection members, too, are moved to the fabric covering department.

Work in this department is done from left to right, more or less standard equipment, with two possible exceptions. One is a sandwich-type rack on which engines are held while being removed the ribs, for the strapping has two independent steps as we are believed that the structure may be turned to any position.

From the covering department, wing, empennage and fuselage sections then proceed to the paint and dope department. Temperature of this room is thermodynamically controlled, and struc-

ture remains on the shelves on which they were transported to it.

At this point all empennage and empennage have passed in and through sub-assembly stations and are headed for the final assembly line. While heading empennage present each actual configuration of the overall layout, it might be said that the floor plan of the Depot is a continuous grid. Rugs are made in one row just below the "corner" where disassembly takes place. Parts and assemblies flow upward, with a few directly forward, to their respective final departments. Thus the flow is across the grid to the opposite

end where the components enter the final assembly line, in direction being from top to bottom of the rectangle or grid. In the "lower right corner" the plane exits to the test flight ramp.

The final, or assembly line, is divided into two stations and all parts notified in them are "inspected" about and stored adjacent to them. Tubes in numerical order, necessarily is selected to follow:

Station No. 1—Instrument panels (from the instrument laboratory) are installed in the completely assembled and is covered fuselage.
Station No. 2—Tail wheel and main-

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ways (the latter for short axial displacements) are attached.

Station No. 3—Gas tank (also from sheet metal) is installed. All fittings assembled and tested.

Station No. 4—Rear-engine assembly is attached and rigged at this point.

Station No. 5—Landing gear (from the hydraulic department) is attached.

Station No. 6—Rigger arrives on an assumed stand (from the engine fuel assembly department) and is installed and all connections are completed.

Station No. 7—Wings (from the point and slope department) are joined to the now virtually-complete ship.

Station No. 8—Final rigging is completed in the station.

Station No. 9—Final and Army inspection, including "final shakedown" and any changes ordered, are made.


Station No. 10—Compass is swung and ship is readied for its test flight. Its own test point takes charge at this station and inspectors can change or adjustments be made necessary. When these are completed the new completely rebuilt plane is ready to taxi out.

In many ways these traditional planes are better than new ones, for they have been understood and are the very latest thing in their particular type of ship. And, having had hundreds of hours of actual service, every part has been thoroughly re-proven.

How production of rebuild differs considerably from actual manufacture, of course. But many of the lessons the industry is learning through quality production can be applied to the rebuild situation. Among these are the breaking down of operations into standard segments, better materials and specialized workers and keeping the depot in order and clean at every efficient manufacturing plant must be.


It may be on the optimistic side to say, in the not too distant future, great mass-production rebuild stations at principal airports throughout the nation turning out their work in much the same way that DeSoto does it. But, it seems, "every man's" plane is even to become popular, something like that will have to come about.

It isn't logical to expect aircraft stations to spring up at anything like the density of automobile garages, or in such intimate locations, either. Just as the airplane is an entirely different vehicle, its future servicing plants will most likely be entirely different from those of the automobile and of automobiles at the airports. As most of these are still to be built, perhaps it would be well to include in these plans provision for mass-production rebuild facilities. The workers, already rapidly approaching peak volume of overhaul, can be relied upon to expand their facilities in their direction without pausing.



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It isn't logical to expect aircraft stations to spring up at anything like the density of automobile garages, or in such intimate locations, either. Just as the airplane is an entirely different vehicle, its future servicing plants will most likely be entirely different from those of the automobile and of automobiles at the airports. As most of these are still to be built, perhaps it would be well to include in these plans provision for mass-production rebuild facilities. The workers, already rapidly approaching peak volume of overhaul, can be relied upon to expand their facilities in their direction without pausing.

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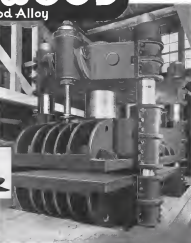
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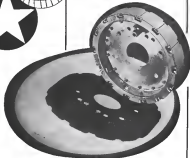
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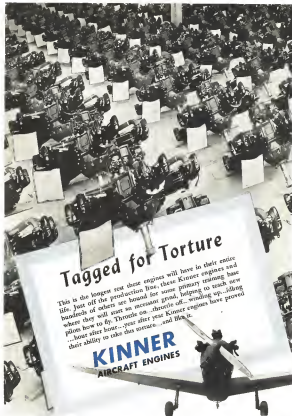
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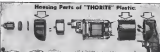
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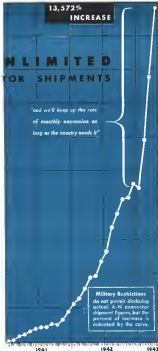
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Searle No. 479 R-1

Finger pressure will not only test the bulb for burn-out on the new Searle indicator bulb.

Searle "Tell-Tale" Testing Light's S.A.E. 101 and 102 are right with standard of plastic, heavy protection and design to combine in good arrangement, and for other control or test mounting systems. These are equipped with a variety of independent coils and each mounted in a series of what bulbs. After checking of indicator bulbs can be used on the standard device.

S.A.E. 101 comes with a lens and make direct in general situation of controls, relays, etc.

Use the finger tip to apply full pressure on the indicator bulb.

—Searle "Tell-Tale" Testing Light

Searle Aero Industries, Inc., 51 Orange, California. Question: Please send me details on Searle 101 and 102. My name is [Name] and my address is [Address]. Searle "Tell-Tale" Testing Light, S.A.E. 101 and 102.

Name _____
Company _____
Address _____

Provides instant burn-out test. New Searle "Tell-Tale" Testing Light—now available for general use for the first time—provides features never before incorporated in an indicator light. It does away with chance taking, saves precious seconds in critical moments.

Bulk into the light is a means for instantly testing the bulb in the indicator lamp without removing it from the light assembly. This feature eliminates our switches and separate wiring for them, effects a saving in weight and reduction in cost. A rotating jewel assembly makes it possible to raise or lower the brilliance of the indicator light, eliminates need for rheostats.

Reasonable delivery dates being met on all orders accepted. You are invited to submit any of your engineering problems involving use of indicator lights.

A Searle Product

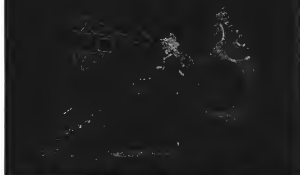
TELL-TALE TESTING LIGHT

OUT OF THE DARKNESS COMES

Zyglo

(REG. U. S. PAT. OFF.)

TO PUT THE FINGER ON FAILURE



The New Inspection Method Now Ready to Speed Your Output of Perfect Parts [NON-MAGNETIC AS WELL AS MAGNETIC]

An
Informative
Bulletin
Also
Ready

• Zyglo Flash-Light Inspection now takes its place beside the accepted Magnaflex Method as Industry's means of producing areas of probable failure in non-magnetic parts. Announced some months ago, Zyglo has been put on a production-line basis in selected plants where it was needed most under war conditions. Aluminum castings (and other light metal parts) for the airplane program have had the touch of Zyglo inspections put on them before assembly—before they away a defect into finished products—long before the possibility of failure in battle. Another factor in the expediency of American arms!

In the illustration, here, of aluminum castings—dipped in a persistent fluorescent liquid, then rinsed, dried powdered and observed under black light—serious shrinkage cracks were shown up. The glowing fluorescent indications signal the exact locations in which the greatest weakness during stress, then developed finally on the surface under capillary action by the powder.

Zyglo, with its laboratory gears behind it, has met the test of the production line with thoroughly practical results. Clear, easily interpreted indications facilitate handling without delaying the flow of work by direct savings of labor, wasted when defective parts are assembled. Enormous indirect savings through prevention of failures.

To fit Zyglo into the routine of factory or overhaul shops a line of equipment has been developed. A complete compact unit and an arrangement of larger capacity units are shown below to indicate the range of accessories. Not only the practical equipment is available to licensed Zyglo users, but the full Magnaflex Service. This amounts to a consulting consulting and engineering service on flow detection.

A great percentage of American manufacturing will find applications for Zyglo in the occupation of the final war and early postwar years. You are urged to contact the Magnaflex Corporation to determine definitely the advantages of Zyglo in your plant. Write, requesting the new Zyglo Bulletin.



MAGNAFLUX CORPORATION
5906 Northwest Highway
Chicago
NEW YORK DETROIT DALLAS LOS ANGELES

MAGNAFLUX CORPORATION

Complete Zyglo Inspection Station 24.20
for metal volume or laboratory

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more lives
 than a cat



Apex Phillips Power Bits do wear out eventually, but Apex Reconditioning Service gives them many lives.

When you have Apex-Phillips Bits reconditioned, you not only save important money, but you help our War Effort by conserving a vitally critical material . . . Tool Steel.

Do not scrap your worn out Phillips Bits—send them to us for reconditioning. They will be returned promptly, just as good as new bits.

When you buy Apex-Phillips Bits and use Apex Reconditioning Service you can then be sure your tool cost per thousand screws driven is down to rock bottom.

Write for Catalog # 15 for complete information.

APEX

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Manufacturers of Power Bits for Phillips, Standard, and Clark Hand Screws, and Hand Tools for Phillips and Clark Hand Screws

Phillips Bit Reconditioning Service for the Pacific Coast at the Burkin Co., 3421 Glendale Blvd., Los Angeles, Calif.

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THERE'S a new flag flying over our plant—our distinguished service medal—the Army-Navy "E" Award for excellence in war production.

Quietly, traditionally, KELEKET performs the job assigned—and in the performance makes a "major contribution to victory."

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EXPERIENCED PRODUCTION

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may need built of wood—solid or
laminated.

- Complete engineering, research, and
planning facilities coordinate the produc-
tion of 15 leading, successfully functioning
Grand Rapids woodworking factories.
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floor space available. Usually hundreds
of feet, modern woodworking machines.
Ample labor supply.

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Aviation experience includes important
parts and assemblies from large bombers
to small biplane planes and including gliders.

GRAND RAPIDS INDUSTRIES, INC.
MONUMENT SQUARE BUILDING GRAND RAPIDS, MICHIGAN



Your inquiries are invited
and will receive imme-
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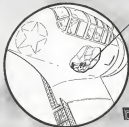
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WHEN **WAR** DRUMS BEAT NO LONGER

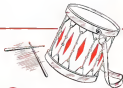
★ Look ahead to the year of 194X.

Allied troops are marching in victory through the streets of Berlin and Rome and Tokyo. The Axis is smashed. And, before all America, there lies a future brighter than ever before.

Men of aviation know that the time for conversion is at hand . . . the turning of their gigantic industry from war production into the manufacture of planes to transport the free peoples and the commerce of a new, peaceful and busier world.

It is for that year, that day, that we are making ready. There will be AFCO Fittings designed as exactly and produced as skillfully for the planes of peace as there have been for the planes of war.

And, even now, we are working with forethought plane builders is planning for their fitting needs of the hour when war drums beat no longer.



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NEW "AN" TYPE PIPE
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FITTINGS OF QUALITY FOR PLANES OF WAR AND PEACE
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AVIATION, Jan., 1945

IN THIS *Global* WAR



HOWARD AIRCRAFT

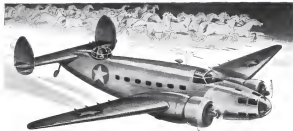
Is engaged in an all-out effort to build fine training planes for the finest pilots in the world—those who fly for the U. S. Navy and the Army Air Forces. Better planes and better pilots will do the job.



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GSRP11A-100A

Contact Rating—20 amp, 12 or 24 v. d.c.



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Contact Rating—3 amp, 24 v. d.c.



PUSH-TIGHT RELAY
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Contact Rating—10 amp, 10 or 24 v. d.c.



MULTIPOLE RELAY
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Through long experience in the field of special application motors, we have learned that thorough engineering and precision manufacturing plus rapid inspection and testing, are the factors necessary to produce these vital characteristics of smoothness and reliability.

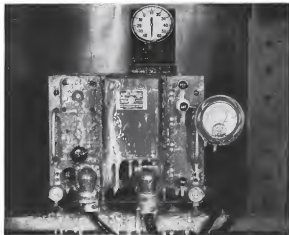
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FRACTIONAL HORSEPOWER
SPECIAL APPLICATION MOTORS



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No radio equipment could remain operative under such conditions until scientific research solved the problems of freezing controls, freezing, sensitive relay jamming, electrical adjustments changing and wires snapping. Without research, radio and electronic systems fail in these frigid temperatures where our

men and planes are fighting in their conquest over cold and altitude and the enemy.

To permit accurate scientific investigation of these problems, RCA recreates this intense cold as its laboratories, cold that is 9° lower than the stratospheric temperature, cold that equipment such as the least-tested transmitter shown above must withstand for endless hours.

In these key chambers RCA engineers are looking ahead to the future, solving the problems that will be encountered as our fighters and bombers operate higher and higher

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Daily these engineers patiently work, subjecting equipment to temperatures as low as -76°, testing and retesting until operation is satisfactory—until dependability is assured. Thus RCA research helps to make our aviation radio equipment more efficient, more powerful, and more reliable in performing its vital tasks.

That's one reason, too, experts say. For results in aviation radio performance, consult RCA research.



RCA AVIATION RADIO

RCA Victor Division • RADIO CORPORATION OF AMERICA • Camden, N. J.

A NEW TORQUE WRENCH

An Important Development in the Hand Tool Field

The New Livensont Torq-Snap Wrench can be used efficiently in total darkness and in noisy areas as well—inside a wing, hull or semi-dark hangar—on the flight ramp or on the field with engines running.

When the proper predetermined torque load is reached, the Torq-Snap gives both an audible "click" and a definite physical sensation which is transferred to the operator's palm. No visual attention is necessary. No dials or battery-operated indicators are involved.

Simple in design, this new torque wrench works on the principle of spring bar deflection. The deflection in the main bar bends



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pre-set, is reached.

The Livensont Torq-Snap was developed for one of the largest aircraft manufacturers to apply proper torque loads in aircraft plumbing—and it has passed exhaustive tests. It operates within a very close tolerance and eliminates hazardous variations formerly unavoidable in vital aircraft plumbing connections.

Twelve sizes are available with open or box ends, either offset or straight. Write for complete specifications (on your firm letterhead, please).



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Now—three new "E's" in Reeves

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In addition to this increased production, Reeves laboratory experts are constantly co-operating with the Government in the development of new fabrics such as the six-ounce Army Twill and Marine Corps rating to help our fighting men master the elements and beat our enemies.

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Swarms of Flying Fortresses fly on Studebaker-built Cyclone engines

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travel so fast, so far, so high. Each of these supercharged engines we build adds new lustre to a Studebaker reputation for sound craftsmanship that now spans more than 91 years. Studebaker equipment at the battle fronts will be succeeded, one day, by new and finer Studebaker cars and trucks for civilian use. Until that day, our first and only consideration is helping to arm our Nation and its Allies.



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(Method 11)

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Surely the better, brighter world for which we fight today will see many amazing improvements in land, sea, and air travel. Just as surely, too, will a great many post-war commerce, culture—travel, business, airplanes, and boats—benefit by the dependability and workmanship of modern Adlake Specialties and Equipment.

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<p>with photographs, charts, and simple, non-technical text.</p> <p>BULLETIN No. 417</p>	<h3>ASSEMBLING AND RUNNING-IN ENGINES AND MACHINERY</h3> <p>List 10 advantages of adding dag colloidal graphite to liquid lubricants for these operations and tells why.</p>	<h3>PARTING COMPOUNDS</h3> <p>Tells how dag dispersions prevent objectionable freezing, rusting or sticking together of metals and other materials. Also use on screw threads, lamp bulbs, aviation and driving equipment; also on glass, rubber and laundry industries.</p> <p>BULLETIN No. 418</p>	
<p>green coatings, lin. cook, bottle and die casting machines, etc.</p> <p>BULLETIN No. 422</p>	<h3>HIGH TEMPERATURE LUBRICATION</h3> <p>How dag colloidal graphite takes over when the fumes get too hot for conventional liquid lubricants. Gives examples in forging.</p>	<h3>"dag" COLLOIDAL GRAPHITE FOR IMPREGNATION AND SURFACE COATING</h3> <p>of textiles, asbestos, felt, shrooves, porous metals, paper, wood, etc. to impart lubrication properties, electrical conductivity, opacity, color, or other desirable qualities.</p> <p>BULLETIN No. 421</p>	
<p>The story of dag colloidal graphite, 12 pages fully illustrated. Gives the how and why of colloidalization, explains the various liquid carriers and suggests dozens of places where dag dispersions can speed up production.</p> <p>BULLETIN No. 419</p>			<h2>dag ACHESON COLLOIDS CORPORATION</h2> <p>East Warren, Michigan</p> <p>Please send me free copies of the booklet checked below:</p> <p>No. 417 <input type="checkbox"/> ENGINE _____</p> <p>No. 422 <input type="checkbox"/> COMPANY _____</p> <p>No. 421 <input type="checkbox"/> POSITION _____</p> <p>No. 418 <input type="checkbox"/> ADDRESS _____</p> <p>No. 421 <input type="checkbox"/> CITY & STATE _____</p> <p>Our Premium Oil Dispensary is available (without charge) to all companies.</p> <p>Free 12</p>

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from metal...large or small
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executives who will have persistent mechanical parts or
complete assembly problems to solve... but we're working
24 hours daily on aircraft assembly and can permit no
visitors. You can visit our plant and feel our spirit by way of
our 34-page brochure "Ingenuity". Write for it (using your
business letterhead, please). We're sure you'll find it an
answer to your problem. Joseph J. Cheney, President.



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ESTABLISHED 1923

TOOL & MANUFACTURING CO., INC.
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BURNDY
multi-range
HYPRESS
(type Y-HSC)

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attaching BURNDY small wire terminals and connectors... even
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Burndy HY200 — compact, one-
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PHOTOPRINT COMPANY

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<input type="checkbox"/> Send Your Wheel		
<input type="checkbox"/> Size		



Highlights of 1942 Operations . .



DURING 1942, Briggs Manufacturing Company turned out aircraft and ordnance materiel in large volume—part of its war orders which now amount to about \$500,000,000.00 . . . more 32,600 men and women were employed, of which approximately 10,000 were women . . . peacetime peak employment rolls numbered about 23,000 workers.

Sharing its work on some 50 war contracts with more than 1,000 subcontractors . . . as was its peacetime practice . . . Briggs Manufacturing Company completed two large aircraft contracts started in 1941 . . . continued on another . . . tooling up and reached volume production on seven other aircraft and two ordnance contracts . . . began tooling on four new war jobs.



BRIGGS Reports on War Production

Wing Production in Four Figures

At the present time more than 90% of the plants, equipment and tools of Briggs Manufacturing Company are being used in war work . . . Since early 1940, we have been making 75 different kinds of wings, flaps and various other assemblies for four-engineered bombers . . . Production on these items has increased more than eight times original schedules . . . During 1942 we completed two large contracts for outer wings, wing tips and ailerons with production well into four figures . . . and new orders are now in work calling for much greater production . . .

Aircraft Parts for 14 Cancons

In June, 1942, we began deliveries from several plants of outer wings and wing flaps for a fighter plane . . . our production rate on these is now six times what was originally scheduled . . . Production was stepped on another important con-

tract for B very large items, one of which, an outer wing section, is 17 feet long and 14 feet wide . . . Heavy landing flaps, bomb-bays and other large assemblies reached volume production . . . work on inner and outer wings and flaps for medium bombers was started . . . we are shipping finished aircraft assemblies and aircraft parts to more than 35 different sources in the United States . . .

Five Power Turbines, Flame Disruptors

One of our biggest contracts is to make forty-five power turbines for heavy bombers . . . In May, 1942, we moved into a large new factory, built for the specific purpose of making turbines . . . later a new model was put into production . . . and five power turbines are now being rushed to meet the need . . . Consisted of more than 2,800 parts ranging from tiny one-ounce ball gears to huge 45-inch aluminum castings, these forty turbines require top manufacturing skill . . . Flame disruptors to protect night-flying bombers are another Briggs war contract . . .

30-Ten Tank Hells, Centrifuge Cases

During 1942 we also began work on the expanded program for General Sherman tanks . . . welding the heavy hulls for these 30-ton giants . . . and supplying many of the sub-assemblies that go with the hulls . . . This work enabled us to use peacetime equipment . . . and the same is true of war work on centrifuge cases for T1 mine neutralization which we helped redesign, changing to steel from casted brass . . . Similarly, we redesigned large moonlight engines from aluminum to steel . . . then enabling us to use many peacetime automobile body presses and machines . . .

Civilian and Military Training Schools

In conjunction with all our contracts, we conduct training schools . . . In addition to newly trained technicians, nearly 18,000 employees have been trained for various aircraft work . . . More than 3,200 soldiers, too, have been taught aircraft

turret maintenance in the school we developed for the Army Air Forces Technical Training Command . . . In October, November and December, 1941, and in January, February and March, 1942, our school was the selected "Efficiency School" for having the highest efficiency record of any school in the eleven states of the Second District.

"E" Award and Patriotism of Employees

On September 27, 1942, the General Aircraft Division of Briggs Manufacturing Company was awarded the Army-Navy E Flag . . . More than 97% of our employees participate in our voluntary payroll savings plan to buy War Bonds . . . \$21.32 is the average monthly pledge per employee since 3,353 former Briggs employees have entered our country's Armed Forces . . . And in the 1941 Red Cross Drive, Briggs employees donated \$62,921.00 as compared with \$11,625.80 last year . . . an increase of almost 500%.

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N. D. Robinson, Vice President and Assistant General Manager

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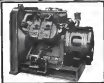
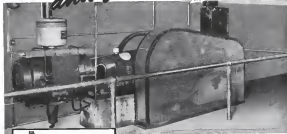
BRIGGS MANUFACTURING COMPANY
DETROIT



**For Today 1943...
and for 194X**

1943
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

194X
JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC



TODAY'S plans must provide for a supply of compressed air that's big enough to do the job—a compressed air source that won't "let down" during emergencies. Tomorrow's plans must assure compressed air at the lowest possible cost—to fit competitive conditions.

Meeting both of these requirements, Gardner-Denver "BX" Single Stage Horizontal Air Compressors (silver foil), dependable air output, yet their horsepower requirements remain unusually low.

HERE ARE SOME OF THE REASONS WHY:

1. Oil-free construction that keeps all air and gift out of the product.
2. "Air-tightened" Duo-Plate makes that actually become tighter with use.
3. Positive lubrication that forces ample oil to all bearings and moving parts.
4. Balanced construction that assures an exceptionally smooth-running machine.
5. Electro-pneumatic control that automatically fits air output to air needs.
6. Capacities range from 88 to 1292 cubic feet displacement per minute.

For high efficiency air output in small space, Gardner-Denver "WB" Two-Stage Vertical Air Compressors are water-cooled for cooler operation. Furnished with direct motor mounting or with alternate or "V"-belt drive, displacement ranges from 142 to 445 cubic feet per minute.

For complete information on Gardner-Denver "BX" and "WB" Air Compressors, write Gardner-Denver Company, Quincy, Illinois

GARDNER-DENVER Since 1859



AVIATION, June, 1943



Pilots from 29 Countries Trained at Southwest Airways

Men from 29 countries have been sent to Southwest Airways for Primary, Basic or Advanced flight instruction—training which helps keep their flags flying as symbols of freedom over every continent. • There's every facility available at our four fields to equip these young men for the job ahead, to give them skill superior to the enemy...to handle themselves effectively in hazardous operations...complete their missions and return safely home with ship and crew. • Trainees to how well they

have learned is more than just the many citations and decorations earned in combat on every fighting front. It is the hundreds of other planes which fly today in every corner of the world, too—transport, trainers, cargo planes—all with men at the controls who earned their wings with the Thunderbolt. • In learning to fight and fly together, they also are learning to keep the peace together, uniting still further the nations of the world for the peace-time understanding which is to come.

SOUTHWEST AIRWAYS Phoenix, Arizona

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The Rosan Locking System has completely solved the problem of locking studs into most materials permanently in board or other materials.

A seasoned miller engages the outer teeth of The Rosan Locking Ring, "A", while the outer teeth or splines at the ring break their way into the material. Pressure of the expanding material causes the ring to close in on the stud, creating a solid and permanent fastener. Easy to install. No distortion of the material. Standard sizes. Order today.

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If you're carelessly "painting" the floor of your plant with inflammable, slippery oil, you need Speedi-Dri. Take a walk through the shop. Notice the condition of the floor around the machines. Can you possibly overlook the danger of your employees slipping in that oily mess? Think what a carelessly dropped match or cigarette might do!

Speedi-Dri soaks up grease and oil like a sponge, sets up an unbreakable shielded surface and blocks the spread of such fires. So great is its efficiency for oils that, in time, it will pull oil deposits right out of the floor, restoring the original appearance. Speedi-Dri saves machines' shoes from oil, reducing the danger of fast wheelies. Easy and quickly spread by hand, it conserves cost money. No matter what you use as a new liquid, Speedi-Dri can do the job better, faster, cheaper. Free of any setting, Speedi-Dri is your own shop. (When used in paint or water soluble oils are used, ask for Sol-Speedi-Dri.)



Ask for demonstration or write for a generous free sample of Speedi-Dri.



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Here's to You, HIROHITO



Danly Machine Specialties, Inc. do not make kura-kari swords. We are, however, in the production line for a myriad of war materials.

We went to 3-shift operation in June of 1946. We did it for defense. We saw you coming, Hirohito, before Pearl Harbor. Danly Die Sets today are holding the dies that popped out plane parts, rifle parts, machine gun parts, tank parts, ship parts,

submarine parts, parts for the defense of America and the defeat of the Axis.

Danly Weldments sold the sea, roll with the caissons, for your doom and defeat, Hirohito, and the doom and defeat of your partners.

You dared to challenge the American workman in his chosen field—Mass Production—and to threaten the security of his homeland.



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Welded Steel Fabrication

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Lest We Forget

ARTIST: J. L. L.

These Koppers Products

*help to blast enemy installations
and protect our own*

Piston Rings



Flying Fortresses travel on Koppers Rings—Koppers is the nation's largest manufacturer of aircraft piston rings. Its rings were on the Flying Fortress that took MacArthur to Australia, on the Navy plane which rescued Rickoverback, as well as in the PT boats that took MacArthur out of Burma.



Whether in the foundry, the shop, the inspection department of American Hammered Piston Ring Division, all know that sometimes life may depend upon such rings they make... which helps explain why every American Hammered Piston Ring delivers that all-important last ounce of effort in time of need.

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The proven ability of pressure-treated timber to serve for years provided a huge reservoir of permanent construction materials for important war and civilian uses in hangars, plants, tanks and bridges. Millions of board feet have been pressure-treated in Koppers plants to resist fire, decay and insects.



You can "treat" pressure-treated wood structures, have material pre-treated to specification for rapid assembly with local labor. Koppers has complete facilities for handling, conditioning, fabricating and treating wood with all recognized preservatives in 21 plants strategically located.

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THE INDUSTRY THAT SERVES ALL INDUSTRIES

Valve Maintenance is vital to Compressor efficiency



Class T Horizontal Double-Acting Compressor
with overhead motor mounting

INSPECT AND CLEAN VALVES REGULARLY

STRAIGHT valve lift without bending, rubbing or distorting... low discharge temperatures and low impact force resulting from low air velocities... lightweight valve discs of heat treated and ground stainless steel... stainless steel valve springs—all give CP Simplex Valves outstanding durability. They should, however, be inspected and cleaned at regular intervals, depending upon operating conditions. The precautions illustrated will help keep a compressor at peak efficiency and reduce maintenance.

HOW TO GET MAXIMUM SERVICE FROM YOUR CP COMPRESSORS



At regular intervals, remove CP Simplex Valves for inspection and cleaning. Examine them carefully for wear. Carbon formation, resulting in leakage and excessive temperature indicates the use of either too much oil, or the wrong kind of oil.



When reassembling a CP Simplex Valve, after inspection and cleaning, always make sure assembly is squarely on seat before putting on cover.

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AIR COMPRESSORS
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"What's this, Tojo?"



After Victory...

Herron-Zimmers will return to the production of metal moulding for the automotive and building trades... with advanced designs and improved quality moulding from the present efforts of our design engineers and metal technicians in their on-going search for better performance.

If we could take Premier General Hideki Tojo through the spacious, industrious Herron-Zimmers plant in Detroit, his beady little Jap eyes would fairly bulge through his thick-lensed glasses. For big things are doing at Herron-Zimmers—things that spell a bad day ahead for the Axis. From the peace-time production of metal mouldings, Herron-Zimmers turned itself almost overnight to the design and fabrication of the highly accurate jigs and fixtures demanded in the assembly-line production of improved aircraft and other armament.

To help you solve your air production problems, the counsel of Herron-Zimmers technicians, skilled in the engineering and building of accurate jigs and fixtures, is at your service without obligation.

for more accurate jigs—featured, write

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A Salute TO THE INDUSTRY

One of the most outstanding aviation articles ever written is in the July issue of Air Trails Pictorial. "Stalin's Falcons," by Major Vasily Kholmikov, pays a real tribute to the American aviation industry. This article, sent to Air Trails direct from Moscow, reveals the complete record of an American squadron and details its service over the Luftwaffe.

This sensational story of a crack Russian fighter squadron using American equipment gives an authentic, word picture of one of the most discussed phases of World War II—the performance of American combat planes on foreign fronts.

Be sure to read this exclusive article in the July issue of Air Trails Pictorial.

OTHER FEATURES IN THE JULY ISSUE:

WILL I STILL BE A PILOT? By Robert T. Page
GIVE THE "GIRLS" A BREAK!

THE "EXPERIMENT" By Congressman Jennings Randolph
By Alice Davidson

ALSO

THE NEW LIGHTS

BOY, ENOUGH

TWO PAGE PHOTOGRAPHIC SPREAD
ON THE "GIRLS" IN THE "EXPERIMENT"

BE SURE
TO READ

AIR TRAILS

FOR YOUTH IN AVIATION
Pictorial



FOR JULY

ON SALE AFTER JUNE 15TH

79 SEVENTH AVENUE, NEW YORK, N. Y.

AVIATION, June, 1945

SENSENICH *Propellers*



SENSENICH Propellers, accepted by the Army, Navy and War Training Service as standard equipment on the primary training planes, are now being used as standard equipment on the advanced twin-engine Trainers, in which our Bomber Pilots receive the schooling that is proving so effective against our enemies.

This acceptance proves the reliability and efficiency of SENSENICH Propellers—and the high degree of engineering and craftsmanship demanded of SENSENICH in their product.

When Victory has been won and Peacetime Aviation resumed, SENSENICH will take their place as one of the leading manufacturers of propellers for Commercial and Private flying.



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Courtesy Bell Aircraft Corp.

Tips on finishing transparent plastics

THE aircraft manufacturing industries face special problems today in the finishing of transparent plastics. Therefore, an understanding of the abrasive products and methods of use best suited to their solution is important.

The picture above shows a process employed by Bell Aircraft Corporation using a Carborundum Broad Silicon Carbide cloth sleeve to finish the edges of enclosure sections for Aircracor cockpits. Abrasive discs, sleeves, belts and sheets are all widely used throughout the aircraft industry to meet the various finishing conditions encountered.

For best results in most edging operations, surfaces should be operated at about 3,000 feet per minute. In general

it is better to use a wet sanding process than a dry, in order to reduce heat, settle dust, eliminate loading of the abrasive surface, speed cutting and increase abrasive life. For surface finishing it is well to select as fine an abrasive as possible. One just fine enough to remove any scratches left by the previous operation is usually the right choice. This is a typical example of an operation employed on one of the newer materials of construction in metal finishing operations. Also in Broad Abrasive Cloth is its various forms—discs, sleeves, belts and sheets—it is used extensively.

Whenever may be your use of abrasives, we ask you to remember one thing every abrasive tool is a "Weapon for Production", it's important to use it wisely.

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ABRASIVES PRODUCTS



THE CARBORUNDUM COMPANY, NIAGARA FALLS, N. Y.

MANUFACTURERS OF GRINDING WHEELS, COATING ABRASIVES, RUBBER EFFECTORIES, HEATING ELEMENTS
Sole Offices and Warehouses in New York, Chicago, Philadelphia, Detroit, Cleveland, Boston, Pittsburgh, Cincinnati, Grand Rapids
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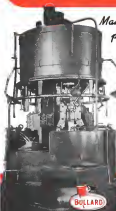
Man-hours required to produce a big Army Bomber

Estimate (1940) 110,000
Actual (1943) 23,000

Yes, it's a fact. America is building her bombers in a trifle over one-fifth the time originally anticipated. This is based on a statement made by Robert P. Patterson, Under Secretary of War.

Miracles like this don't just "happen". They come from intelligent planning. And in the making of airplanes, they come from the most generous sharing of experience and improved methods any industry has ever known.

Bullard is proud that so many V.T.I.s and Multi-A-Matics are helping in this vital work. More Bullard machines are making airplanes today than are engaged in any other industry. And Bullard wishes to contribute all the "know-how" in their experience to ensure that every one of these machines does its utmost to push production schedules still further. Call on the Bullard technical staff whenever there's a chance that we can help.



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The name "IRVIN" on the harness means the chute is produced in an Irvin Factory with over 30 years' experience and skill in chute-making.

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Many of the personnel of the flying services are owed to all pilots of war have successfully used their Irvin Air Chutes in extreme emergency.

The word CATERPILLAR and the representation of a caterpillar are registered trademarks of Irvin Air Chute Co. Inc. We are anxious that the records of the Club be kept as complete as possible in the Club Register and members upon enrollment will receive a caterpillar token with the name awarded license. Communicate with Main Office.

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As part of their Invisible Crew, Bendix hydraulic controls are in service aboard these Liberators, as they are on virtually every other U. S. fighting plane now in production.

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Some of our Aircraft are Missing

...when a
single department
gets out of step

Let our production machine begin to get "out of sync" with the others on the line, and a whole department is headed for trouble. Parts turn up missing at final assembly and planes turn up missing right when they're most needed to do a stress-testing job in the sky.

There's no reason for such hold-ups, when it's a simple matter to put on each machine a mechanical safety that will report any slowing-down in plan-

black-and-white, as soon as it begins to develop. These are Veeder-Root Counting Devices, mechanically and electrically operated, which can be easily installed on any type of machine or process, without interfering with production. These devices count in any units or units of performance... provide operational reports that enable your production men to police their lines more effectively than ever before. Write Veeder-Root Inc., Hartford, Conn.



Veeder-Root Counting Devices

Fighters are only as fast as THEIR TIRES!



*Drawing from actual photograph
of a cannon-bearing Bell Aircraft
Army P-51 Mustang.*

The faster a fighter is in the air...the faster it has to take-off and land...naturally.

American engineering genius was more than equal to the challenge of giving us the world's fastest fighting planes...but it was up to General to build a tire that could take the terrific punishment on the ground.

Now...every day...America's fighters are proving that they have the fire-power and speed it takes to keep command of the air...and General Tires are proving that they can take them up and put them down safely.

For every kind of ship, General is supplying tires with the built-in strength and quality that spell safety. For your safety, too...depend on General.

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FOR QUALITY AND SAFETY

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THAT HELP GET THEM FLYING, SAILING
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NIGHT FIGHTER . . .

WONDERFUL organization by which heeded the voice, initiative, skill and courage of gallant men and—this must not be overlooked—superior performance by aircraft, all combine to establish the R.A.F. supremacy in the air night and day. There must be no "margin for error" in the performance of high powered aero-engines! They must give immediate response to the pilot's demands, even under the terrific buffeting of battle conditions.

Even in the fiercest dog fight power and speed must be maintained. When engines are "fed" with air, oil and fuel all free from impurities, they give of their best. That is why on night fighters, battle planes, indeed, all types of fighters, spotters, bombers, you will find Vokes Filters in operation. The 99.9 per cent filtration efficiency claimed for Vokes Filters is not a mere laboratory test bench figure. Vokes Filters, we are proud to say, have proved their value to the fighting forces under the most grueling battle conditions in the air and on land and sea.

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DESIGNED FOR NIGHT FIGHTERS

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ATTENTION, June, 1949



5 years of abuse... no signs of wear

AT SPERRY GYROSCOPE COMPANY

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The Resistoflex low pressure hose, shown, carry hammering pressure of between 250 and 300 pounds 12 times every minute. Oil flow varies between 1.0 and 3 gallons per minute. Oil temperature varies from room temperature to 150°F. Most of the hose are bent on a 5 inch radius. . . being coupled and uncoupled constantly, manhandled, splashed with hydraulic fluid. Imagine five years of use under these conditions. . . yet showing

no signs of leakage or deterioration. Resistoflex hose assemblies are in use in hundreds of outstanding applications such as this. Technical data acquired through many of these may help you solve some of your flexible hose problems. Write us about these today, or . . .

SEND FOR CATALOG

Write for the Resistoflex Industrial Catalog. On company literature, please.



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RESISTOFLEX

RESISTOFLEX CORPORATION, BELLEVILLE, NEW JERSEY

AVIATION, June, 1949

"DEATH'S SWIVEL CHAIR"
begins its Turning on...



WHITNEY Aircraft Chains*

When attackers dash in from any quarter, power-driven gun turrets can swing to throw head-on death at the touch of the gunner's finger. This power-impulse is furnished, fully guaranteed whenever Whitney Aircraft Chains are slung on turret controls . . . as well as on other vital mechanisms like automatic flight controls, bomb-displacement gear, door mechanisms, rudder controls and landing wheel keepers. For all these duties, Whitney Chains are chosen for their demonstrated performance.

And another Whitney advantage to wartime US aviation is the direct service of the Whitney Aviation Division, which places all of Whitney's engineering, manufacturing and technical resources at your personal command . . . to engineer Whitney Aircraft Chains and Speedsters into your particular design.

*PRODUCT OF AVIATION DIVISION OF THE WHITNEY CHAIN & MFG. CO.
HARTFORD, CONNECTICUT



North American Mitchell B-25 Bomber

Houdaille handles this danger spot

In landing or taking off, the centering nose wheel on an airplane's tricycle landing gear, if uncontrolled, can be a dangerous trouble-maker. Shaking forces of colossal magnitude could easily cause disaster.

Houdaille Hydraulic Shock Dampers . . . the result of a quarter-century of experience . . .

neutralize these shaking forces, imposing ever-increasing resistance as they mount, yet they offer little hindrance to slow wheel movements encountered in steering.

Today these Houdaille devices are functioning successfully on many types of planes—from the highest speed fighters to the heaviest bombers.

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1,001 NEW USES IN THE AIR



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Largest Independent
Manufacturers and
Distributors of Rubber
and Plastics

AVIATION, June 1945

Originally designed for combat aerobatics . . . where strain and stress impose conditions unknown to pre-war relays . . . the Type 27 Super Aircraft Relay offers numerous advantages for a wide range of other uses.

Double mounted box frame construction provides rugged strength and rigidity . . . Measurements are 1 1/2" x 1 1/2" x 1 1/2" and weighs but 5 ounces. The Type 27 SPDT double make—double break in 2 pole construction can withstand an excess of 15g without a flicker . . . has a 60 gram contact pressure (double make—double break) and a 20 ampere contact capacity at 30 volts d.c. (100 ampere inch). Nominal coil voltage is 12 volts d.c. with a pickup of 6.5 volts (.61 watt) at 20° C. Coil wattage at 12 volts d.c. is 2.1 watts at 20° C. Temperature range is from -40 to +90° C.

Free samples of this relay are available to manufacturers on request if accompanied by a priority of AA-4 or better. Write or wire today requesting specification No. 12723.



VISITRON PHOTOTUBES
are available in quantity in numerous sizes. Made by G-M, pioneer in development and manufacture of quality phototubes.

G-M LABORATORIES INC.

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Buy WAR BONDS & STAMPS

Only JOHNSON BRONZE makes every type of SLEEVE BEARING



A dependable SOURCE of SUPPLY

● There is one right type of bearing for every application . . . one that will deliver the greatest performance for the longest period of time. Johnson Bronze can help you determine the exact type to suit your requirements. Our facilities cover the production of every known type . . . our experience goes back more than thirty years. A Johnson engineer will call at your installation and review your problem. All of his recommendations will be based on facts . . . free from all prejudice. There is one located within easy distance from your office. Why not invite him in . . . today? No obligation, of course.

JOHNSON
SLEEVE BEARING
620 S. MILL STREET



BRONZE
HEADQUARTERS
NEW CASTLE, PA.



How high was "UP"—in 1921?

IN THE DAYS WHEN out-climbing
each other was no problem . . . back
when ball 'ways high-altitude bombing
was still a dream . . . how high was "up"?

The will surprise you, but "up"
was plenty high back in 1921! That
year, Major Schneider set a new record
—34,599 feet. And he did it in a
Packard-built LePere plane, powered
with a Packard-Liberty engine!

Yet, 21 years later, American planes
bombed the Schwartz and Griesma-
ra from 35,000 feet, and the world
looked on with wonder.

Packard built well in '21, and Pack-
ard is building well today. Right now,
Packard-built Rolls-Royce engines are

going to town in Warhawk and Har-
ricane fighters, twin-engine De Havilland
Mosquito bombers, and the giant 4-
engine Lancaster bomber. The tradi-
tion of precision craftsmanship—
working to microscopic limits—in per-
sists.

Packard men and women are hold-
ing to such fine tolerances that parts
may be interchanged with those of
original Rolls-Royce engines built
3,000 miles away. That's the kind of
engine Packard is building in mass
production quantities, by modern mass
production methods.

And that goes for Packard marine
engines, too—the power plants for the
Navy's swift PT boats. Their racing

speed comes from Packard marine
engines mass-produced to aviation
standards.

Until peace comes, we're all out in
war production. After victory, today's
Packard precision craftsmanship adds
up to finer, better post-war Packard
products.

ASK THE MAN WHO OWNS ONE


PACKARD
Precision-Built Power



STERLING 1000

New Electric Portable Sander



**FASTER!
SMOOTHER!
BETTER!**

SWIFT AND SMOOTH!

Get the job done *quicker—and better* with the new "Sterling 1000"! Powerful... rapid cutting—yet, because of skillfully engineered counter-balanced mechanism it operates *without a trace of vibration!* So smoothly does the "Sterling 1000" handle—that women operators prefer to work with this new sander. Elimination of operator's single-jangle nerves alone means higher quality work! And this sander is tough—sturdily built to serve you dependably even under heavy production pressure.

DESIGNED ON NEW SANDING ACTION PRINCIPLE! Orbital, circular, thousands of abrasive grains cut fibers which cross and recross each other. With this action, the "Sterling 1000" cuts faster—produces the smoother surface you've ever known on wood, metal, plastic or composition. Ideal for easy rubbing and polishing operations.

Write today for your copy of the New "Sterling 1000" folder, which describes its 20 important features in every detail.

STERLING TOOL PRODUCTS COMPANY
381 S. OHIO STREET • CHICAGO

114 W. WILMINGTON BLVD., LOS ANGELES, CALIF.

74 WILMINGTON STREET W., TORONTO, CANADA

AVIATION, June, 1949



AIRPLANE ENGINE FILTERS

PROTECT UNITED NATIONS PLANES

On Guard AT EVERY FRONT LINE AIRFIELD

From Tunisia to Guadalcanal, dust is as much an enemy to be fended as the Axis planes themselves.

Airplane engines must "breathe" clean air if they are to deliver their maximum in performance. Dust — due to makeshift air fields in combat zones — accounts for grounding our fighters and bombers after only 30 to 40 hours of flying — unless they are provided with engine filters. Aircraft engines so protected, however, continue to operate efficiently for 300 to 400 hours!

In addition to maintaining maximum efficiency by eliminating excessive wear, AAF engine filters also save valuable replacement parts and greatly reduce oil and gas consumption. More than twenty types of AAF airplane engine filters are being made today for United Nations planes. These were developed in cooperation with aircraft engineers to meet varying airplane construction requirements as well as Army Air Corps specifications. Complete information and performance data are available without obligation. Please write us.

AMERICAN AIR FILTER COMPANY, INC.
346 Central Avenue, Louisville, Kentucky
In Canada: Durling Bros. Ltd., Montreal, P. Q.

AVIATION, June, 1949

Will they take-off in DECEMBER
as they did in MAY?

Whether or not your runways will be kept free of snow next winter depends on the preparations you make during the next few months. Remember—the specialized equipment needed for the job cannot be judged, ordered and made overnight.

Don't wait until the first snowfall and find you are unable to get adequate snow removal equipment. Get the facts now on the Walter Snow Fighters—while you have time for careful

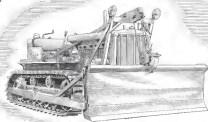
consideration of its exceptional record of performance. Walter Snow Fighters have, many times the snow-clearing capacity of other units. They clear 36 feet widths, at average speeds over 10 mph, through deep snow—clear safe dangerous snow banks—meet every airport snow condition.

There's a big story behind the outstanding performance of Walter Snow Fighters. Their exclusive 4-Point Positive Drive—the same exclusive power of FOUR driving wheels—its positive, non-slipping, non-stalling traction—and many other engineering features, are all fully explained in detailed literature available on request. Write today for this valuable information.

WALTER SNOW FIGHTERS



WALTER MOTOR TRUCK CO. • 1001-19 IRVING AVE., RIDGEWOOD, QUEENS, L. I., N. Y.



The War Tractor hit upon Something in the Vacuum Cleaner

OWEN PATRICK, a vacuum cleaner and a military tractor live in different worlds. The cleaner's job is a light-duty one—and what nations must in emergency. That's why Torrington Needle Bearings were chosen for use in the household machine. With its low friction coefficient and compact design, the Needle Bearing is one of the reasons modern vacuum cleaners can be so easy to handle as a new broom.

The men who drive the tractors, on the other hand, are concerned chiefly with their ability to stand up under the most severe service conditions. But when a new tougher runway is wanted by dawn, or when holes must be repaired while bombers are still in flight, it helps to have a tractor whose mechanism responds quickly and smoothly. So tractor designers, too, turned to the Needle Bearing for long life and ease of operation—and found many other advantages as well. Its seldom-needs attention, thanks to an effective system of lubri-

cation, its resistance to overloading makes easy, because of high load capacity—and its dependable production, through-

out runs of maintenance and ready availability for repeated applications.

SOMETHING TO KEEP IN MIND FOR FURTHER: You'll soon be planning your post-war clean-ups—on perhaps you've already started. There may be an idea for you in the Torrington Needle Bearing. Its advantages are the very features Torrington's engineers are being advanced to work—longer life, greater speeds, greater ease of operation, more compact design, less need of attention. Whatever your design problems, let Torrington engineers help you. They are expert in adapting the Needle Bearing to specific applications. A long list of typical uses is included in Catalog No. 134.

NEEDLE BEARINGS FOR ALL PURPOSES



NEEDLE BEARINGS are produced in a range of sizes for almost every type of machine. They are available in standard sizes, or custom sizes. They are available in standard sizes, or custom sizes. They are available in standard sizes, or custom sizes.

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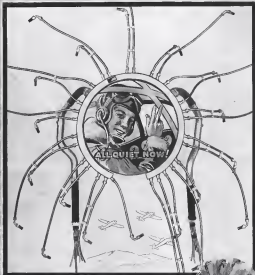
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TORRINGTON NEEDLE BEARINGS

BOLTON SHIELDED IGNITION HARNESS



Keeping the spark in its place!

In its ignition system, a modern plane engine has upwards of 30 lively spark "sending stations." Unharnessed, they would sound like machine gun fire in the pilot's phones. Reducing this unwelcome by-product is relatively simple. Eliminating it (very definitely a "must") requires this carefully engineered shielding harness, now being manufactured for the Government in the Bolton plant.



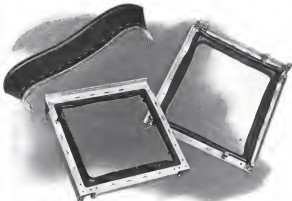
MOUNTED ON A
PRATT & WHITNEY
TWIN WASP ENGINE

BOLTON MANUFACTURING CORPORATION

692 CAMPBELL AVENUE - WEST HAVEN - CONNECTICUT



AVIATION, June, 1943



Bostitched...for speed in assembly

For many years, Bostitch wire stitchers have speeded the fastening of a wide variety of non-ferrous materials, including light metals.

Today, with the development of new stitching wire especially designed for aircraft parts manufacturing (such as American Aircraft Stitching Wire), Bostitching can be depended on for heavier work and precision standards.

Bostitch Aircraft-type Stitchers join metal parts and combinations of metal and other materials where applicable, at speeds at least double that of other fastening methods—in some cases, 8 to 10 times faster. Semi-skilled labor can be used, less inspection is required, floor space is saved.

The staple is formed from wire, and the legs are punched through the work (without pre-drilling), clashed flat on the under side to provide full bearing against the material. The hole is clean, and the fit between wire and perforation is close. Such materials as aluminum can be fastened without danger

of fracture or warping, and the stitch can be accurately and quickly located.

Bostitching is being used for fastening such parts as ducts, trailing edges, fire walls, insulating strips, rubber gaskets, chutes, etc. Other fastening jobs in aircraft plants can be performed by other types of Bostitch machines. From a line of models unrivaled in its completeness, select the ones best fitted for your needs.

BOSTITCH

fastens it better, with wire.

ALL TYPES OF STAPLES APPLIED BY MACHINES
ALL TYPES OF MACHINES FOR APPLYING STAPLES

BOSTITCH

(Beston Wire Stitcher Co., 52 Blackmore St., East Greenwich, R. I. Bostitch-Canada, Ltd., Montreal)

AVIATION, June, 1943

418

Guided by the stars toward
their "target for tonight"...

WEEMS STAR CURVES

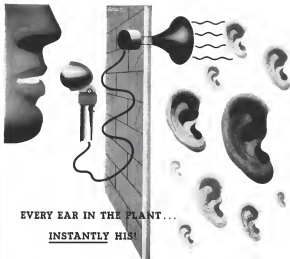
THE WEEMS SYSTEM OF NAVIGATION was established in 1928 and is based on the patents, copyrights, and developments of Commander P. V. H. Weems. It has been expanded to cover the entire field of sea and air navigation. The outstanding contributions by Commander Weems include the Star Altitude Curves, the Line of Position Book, the Second-Setting Watch, the Gold Medal Test Book Air Navigation, Marine Navigation, improvements in the Bureau of Standards Type Aircraft Sextant, the Design of the Air Altimeter and numerous related articles. To those interested in celestial navigation we will be pleased to send complete data fully describing the books and instruments used in connection with the Weems System.

WEEMS SYSTEM OF NAVIGATION
ANNAPOLIS, MARYLAND

EQUIPMENT SUPPLIED BY WEEMS SYSTEM OF NAVIGATION

WIN Speed-Time Distance Calculator
Navigation Note Book & Plotter, Weems
Altitude Tables, Star G
Simplified Celestial Navigation,
Weems and Link
Air Navigation Outline, Excerpts
Use of Pocket Book, Weems
Sign Star Diagram, with booklet
Air Almanac, for 4 months
Radius of Action of Aircraft, Search
Marine Sextant
Second-Setting Watch
Ratchet Chronometer, Weems
Link Averaging Bubble Sextant
Instrument Flying, Weems and Dwyer
WIN Course and Distance Finder
Air Navigation, Weems
Star Altitude Curves, Weems, per 10"
Lat. Road.

LINK
AVERAGING
BUBBLE
SEXTANT



EVERY EAR IN THE PLANT... INSTANTLY HIS!

"Mr. Harker, please! ... Washington calling ... report at once to plant manager."
"Calling Mr. Thomson ... please attend meeting at production engineering office immediately."

What a savings in manpower ... what a savings in valuable time ... when messages are delivered by Straight-Line Communication!

It does the job **QUICKER** and **BETTER** than by any other means ... and the man-hours it saves more than pay for the installation in an amazingly short period of time.

For 49 years Stromberg-Carlson has been developing the finest type of sound reproducing equipment. Why not let us show you how we can solve your own communication problems? Get in touch with the Sound Systems Division of the Stromberg-Carlson Company, 100 Carlson Road, Rochester, New York. Write for free Booklet No. 1932

STROMBERG-CARLSON



STRAIGHT-LINE COMMUNICATION SAVES MANPOWER • SPEEDS THE WORK TO VICTORY

AVIATION, June, 1943

AVIATION, June, 1943



What! Paper oil cans?

...another job for HYCAR SYNTHETIC RUBBER

Keep an eye out for this one . . . you may be getting your motor oil in paper containers before long. Yes, just ordinary, inexpensive paper, but fortified and made resistant to oil and moisture, heat and cold, wear and tear by impregnating with Hycar synthetic rubber.

So effective is Hycar that only a very small amount is needed to transform paper into a tough, durable material impervious to oil, grease and dirt, and resistant to heat and abrasion. This same principle can be applied to similar products: cartons, boxes, protective wrapping for machine parts—and, after victory—bookbinding, luggage, wallpaper and countless others.

The qualities of Hycar that make possible the transformation of ordinary paper into an "oil can"—or perhaps into tough, lightweight, oil and gasoline-resistant paper gaskets or insulator strips—are the same qualities required for scores of aircraft applications today.

Resistance to petroleum products, heat and abrasion, and the ability to remain flexible at low temperatures . . . these are prime requirements for hydraulic hose, seals, diaphragms, accumulator bags and gaskets. Tailor-made for the job, Hycar for aircraft has these qualities in full measure.

Hycar is made in several types, applied to substrates in the form of crude synthetic rubber. We will be glad to work with you and your rubber products supplier in applying Hycar to your problems.

HYCAR CHEMICAL COMPANY
AKRON, OHIO

LARGEST INDEPENDENT PRODUCER OF BUTADIENE SYNTHETIC RUBBER IN AMERICA

DON'T SCRAP

that AIRCO Tip!



**Let an Airco Repair Station
recondition it for you**

Copper is one of the most critical materials. It must be conserved.

Here is one way to do it—don't discard a worn Airco welding or cutting tip until you've made certain it cannot be reclaimed. Send all your damaged Airco tips to us. Our skilled repair men will inspect them thoroughly and put them back into first-class working order . . . unless they're beyond repair.

In this way Airco can help you reclaim many tips that would otherwise end up in the scrap-box. So see that all old Airco tips are collected now and forward them to the nearest Air Reduction office.



Here's a typical result of Airco Repair. The tip at left—battered, cracked, and choked with carbon—was made good as new by skillful repairs.




Air Reduction

General Office: 60 EAST 42nd ST., NEW YORK, N. Y.

IN TEXAS: NASHVILLE-AIRCO GAS PRODUCTS CO.

General Office: HOUSTON, TEXAS

IDLE CYLINDERS ARE PRODUCTION SLACKERS! Keep 'em rolling for victory!



New **BARRIERS** to Confine Electric Current!

War is destructive but not all effort that goes into the big fight is wasted. Some of it is going to pay mighty big future dividends. That is especially true of the war work that is going on in the country's laboratories.

At Formica this work has resulted in the development of some new insulating materials with new and valuable characteristics which will be doing important jobs in American electrical products long after the war is over.

Three new grades MF, FF-10 and FF-41 accomplish things that could not be done previously with this insolated insulation. MF is a glass mat base for applications requiring low loss at radio frequencies (Power Factor .211; Dielectric Constant 4.8; Loss Factor 0.03 at 1 Megacycle).

FF-10 is Fiberglass fabric base material containing good dielectric strength and heat resistance. And FF-41 is designed to resist arcing.

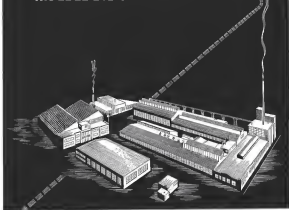
These materials have a new and important usefulness. At present they are available only for the most essential war uses. But later they will be widely applied.



THE FORMICA INSULATION CO., 4628 SPRING GROVE AVENUE, CINCINNATI, O

AVIATION, June, 1943

One purpose...
the **IMPROVEMENT** of Metals



Forge Plant of The Steel Improvement & Forge Co., January, 1943

by **FORGING**

Throughout 30 years of unremitting technical and production effort, marked by one plant expansion after another, this forging organization has invariably utilized the most forging techniques required, to obtain the utmost improvement of metals by forging. Adopting a broad experience, with exacting forging techniques, to the production of forgings for war, is our whole duty today.

DROP
THE STEEL IMPROVEMENT & FORGE CO.
FORGINGS 960 East 64th Street CLEVELAND, OHIO

AVIATION, June, 1943



This year 1943 promises to be the grimmest, hardest year this country has ever faced. Every effort, and every dollar of national income not absolutely needed for defense, should go into war work and War Bonds.

In the Pay Roll Savings Plan, America finds a potent weapon for the winning of the war—and one of the surest guarantees of the preservation of the American way of life!

Today about 50,000,000 wage earners, in 175,000 plants, are buying War Bonds at the rate of nearly half a billion dollars a month. Great as this sum is, it is not enough! For the more dollars made available now, the fewer the lives laid down on the bloody roads to Berlin and Tokyo!

You've undoubtedly got a Pay Roll Savings Plan in your own plant. But how long not once you last checked up on its progress? If it now shows only about 10% of the year's payroll going into War Bonds, it needs picking up!

This is a reëffort—and it needs national attention and continued stimulation to get fullest results.

You can well afford to give this matter your deep personal attention! The actual case histories of thousands of plants prove that the successful working out of a Pay Roll Savings Plan gives labor and management a common interest that almost inevitably results in better mutual understanding and better labor relations.

Minor misunderstandings and wage disputes become fewer. Production usually increases, and company spirit rises. And it goes without saying that workers with substantial savings are usually far more satisfied and more dependable.

And one thing more, these War Bonds are not only going to help win the war, they are also going to do much to close the dangerous inflationary gap, and help prevent post-war depression. The time and effort you now put in selling War Bonds and teaching your workers to save, rather than to spend, will be richly repaid many times over—now and when the war is won.

You've done your bit  **Now do your best!**

This space is a contribution to victory today and sound business tomorrow by Actarion.

Type C2B-1A (Illustrated)—developed especially for aircraft use. Will operate in blower applications on the most adverse conditions. Designed for continuous duty in operation at high ambient temperatures (250° F. or higher) and is a 90° shafted unit. Full bearing support. Built to an exacting standard. Length: 1 1/2" H.P. 2 1/2". H.P. 1 1/2" wide 50" 111 with M.



15 YEAR Performance Record

backs up your judgment when you select Oster motors



This record is your assurance that you are dealing with a seasoned, dependable source — that you are not "taking a chance".... Oster motors, used exclusively before the present war as original equipment on Oster motor-driven appliances, have helped to establish the world-wide reputation of these appliances — for fifteen years the recognized leaders in their field, widely used by the armed services and other departments of U. S. and foreign governments.... The same sound, conservative engineering — the same trained labor force and established precision standards — are behind the Oster motors now being built to power vital instruments and mechanisms in war planes and submarines.... Illustrated is type C2B-1A, 1/100 H. P. model in current production; other Oster models up to 1/2 H.P. Let us help you fit this or other Oster motors to your requirements.

John Oster Mfg. Co. of Illinois, Genoa, Illinois

20-11

489



Can there be a tougher job for MEYERCORD DECALS?

Decal nameplates on propeller blades! Blades that cut the bitter cold winds of the Arctic... the humid air of the Tropics... that claw through sand storms of the desert... cold, heat, the wreck of battle, hour upon grueling hour. That's one of Meyercord's many wartime assignments. Have you a tougher task for Meyercord Decals?

Meyercord Decal engineers are constantly solving problems where lightweight, low-cost, non-metallic nameplates, identification, dial faces, information markers, insignia, etc., are required. Decals are ideal for fast production (quick and easy to apply). Adaptable to any surface. Durable, uniform, highly visible and permanent color. No sharp edges, no screws, bolts or rivets. The unlimited uses for Decals challenge the imagination. Meyercord technical and designing service is available without cost. Address Dept. 1286.



Photo of propellers and material courtesy of Hamilton Standard, Division of General Electric Corp.



FAST • COLORFUL • DURABLE IDENTIFICATION
MEYERCORD DECALS
THE MEYERCORD CO., 3225 W. Lake St., Chicago, Ill.



"LISTEN, HITLER—THE YANKS ARE COMING AGAIN!"

Across the ocean they're streaming in thousands—Yankee planes and lightning men! Our fighters count on swift, sure radio communication—and MURDOCK Radio Phones are serving them with distinction!

The U. S. Army Air Corps uses **MURDOCK RADIO PHONES**

They're precision-engineered for maximum sensitivity—give clear, undistorted reception. Ruggedly built, too, for lasting dependability.

See these "tested-in-action" Radio Phones. Write Dept. 27 for Catalogue.



Wm. J. Murdock Co.
Makers of Murdock Tested-In-Action
Radio Phones Since 1904
Chelsea, Massachusetts



...use parts of AMPCO METAL for safer flight

Bombers must deliver their load and get back—with mechanical equipment in the planes functioning perfectly to assure reliable flight. At vital locations in engines, propellers, and landing gear, parts of Ampco Metal give additional assurance of efficient performance—for in a wide range of aircraft installations, this tough bronze has proved its ability to withstand abuse and wear.

If you employ bronze parts that are unrefined, due to fatigue, wear, or failure, Ampco Metal may prove to be the material that will stand up and give you a full measure of service.

Investigation will prove that the wear-resistance, toughness, and reliability of this bronze can be an important asset to your equipment, delivering performance that is a credit to your selection.

Write today for literature.

AMPCO METAL, INC.
Department A-4

MILWAUKEE,

WISCONSIN



WRITE FOR Brightboy's "Methods and Applications" Data

THAT IS
simplifying and speeding up

- DE-BURRING
- FINISHING
- CLEANING
- POLISHING



Deburring—finishing
up holes and edges
in Alclad part.



New machines and special applications of Brightboy—the rubber cushioned abrasive product—are being introduced daily by the pressure of wartime production.

In Brightboy's comprehensive literature, you will find data showing how Brightboy bridges the gap between a grind and a buff, giving a finish which frequently serves as a final polish—with minimum dimensional loss. Write us if your dealer cannot supply you with Brightboy literature, prices and catalogs. Our field representatives are at your service.

BRIGHTBOY INDUSTRIAL DIVISION
Weldon Roberts Rubber Co.
Newark N. J.



INSPECTION is Vital!



Prior to their conversion to war production work many shops which previously did not need close inspection equipment have discovered that this is one of the price realities for turning out precision warlike parts.

Lombard's series of Surface Plates, as well as complete line of other accurate small tools has made possible greater production under the closest tolerances now necessary.

Available for general shop use as well as inspection work. Prompt delivery can be had in various grades and tolerances in a wide range of standard sizes from 14" x 18" to 48" x 96". Quotations made also on special sizes and resurfacing.

Surface Plate shown is known as Commercial Style.



LOMBARD GOVERNOR CORPORATION
650 MAIN ST., ASHLAND, MASS., U. S. A.



Skilled Workers Make RELIABLE Springs



At Reliable, men and women operators share the responsibility of producing accurate, dependable springs for hundreds of purposes which will speed Allied Victory.

Our many women workers are loyalty performing tasks which require a high degree of experience and dexterity, thus releasing scores of men for our armed services.

Reliable produces quality springs of every type—virtually all our facilities now being engaged for aircraft, military vehicles, arms, and ammunition.

Unusual service and delivery, as well as a capacity for handling most intricate and difficult problems, have made for Reliable workers a distinguished record.

Our equipment—particularly our large tool and die department—is highly modern and adaptable. When the urgency of present war demands is past, remember that Reliable is outstandingly prepared to give you exceptional service on your normal requirements.



Send us your specifications and drawings.

The Reliable Spring & Wire Forms Co.
3187 Fulton Rd. Cleveland, O.

Representatives in Principal Cities

YOU CAN RELY ON **RELIABLE Springs**

MADE IN U.S.A.

How to install and overhaul ALL TYPES OF AIRPLANE ENGINES and ACCESSORIES



Here is a comprehensive and authoritative manual for those concerned with aircraft engines, accessories and others who need a detailed working knowledge of airplane engines and accessories.

The 12 sections contain a wealth of practical information on everything from construction details of all types of engines to suggestions on the care of pistons from instructions for the complete assembly of an engine to methods of spraying paint to a fully illustrated easy-to-understand glossary.

See the facts and figures in outline and unadorned form, compared by Fred Goetz, one of the country's leading writers of practical technical books, and found largely as these instructions look when written.

Aircraft Handbook

By FRED H. GOETZ, Editor Emeritus, *American Handbook*, Revised 1945 Edition, 782 pages
Size 4 x 6 1/2, Illustrations 112 tables \$5.00

GOETZ's *Aircraft Handbook* for mechanical features of airplane engines, accessories, tools and more standard and interesting aspects are methods of installation, disassembly and reassembly, these series for and including their price, an excellent reference to the highest performance of airplane engines and engine work. Check your problems against the detailed pictures as reflected in the text and pages.

The handbook contains all types of engines and their accessories and includes a complete list of the most used engine instruments including parts, parts, etc.—with a complete of comprehensive descriptions (rings, pistons, connecting rods, valve timing, etc.). Here is the source of working ideas, saving time and trouble in planning, and the handbook contains a complete list of the most used engine instruments including parts, parts, etc.—with a complete of comprehensive descriptions (rings, pistons, connecting rods, valve timing, etc.).

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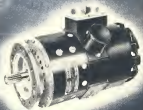
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